THE BRITISH VETERINARY JOURNAL

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THE EMPIRE AND THE THRONE

THE ceremony of the coronation of a British monarch has a meaning and significance which can be appreciated in its fullest measure only by a citizen of the Commonwealth. The central act is one of deep religious significance in which the monarch, being acclaimed and recognised as the rightful occupant of the Throne, solemnly promises to dedicate his life henceforth to the interests and well-being of all his subjects. For the people it is a time of joy and it is right that there should be an outward show of pomp and pageantry, epitomising the history and achievements of a great empire, in which his loyal subjects from the far ends of the earth can gather in London to play their part.

On June 2 a young and beautiful queen will vow to dedicate her entire life to the service of her people. She will take up an onerous task from which there can be no relaxation or remission. Queen Elizabeth II personifies youth and vigour, happy womanhood and motherhood. She represents the princess in a fairy story who, having gained a handsome prince for a consort, shoulders great responsibilities fortified by his love and presence and by the deep and generous affection of her loyal subjects. Her accession to highest office comes at a time pregnant with change in a world striving to overcome the tumultuous effects of two great wars. Governments and dynasties have been overthrown, old-established institutions and traditions have been crushed in the turbulence. In a vain effort to accommodate to a strange new world some peoples and nations have grasped at new faiths and policies in the hope of alleviation or cure, only to find enslavement and despair.

XUM

The British Empire has not escaped unscathed, but the centuries of order based on justice and discipline judiciously orientated from time to time according to prevailing circumstances, and a firm belief in the virtues of " the gradualness of change " have enabled us to ride the storm on such an even keel as to demand the admiration of the world. Great changes have occurred in our mode of life and government at home and overseas, yet one factor has stood superbly constant and firm and that is the family spirit engendered and enhanced by a deep and spiritual allegiance to the Throne. This old Empire needs no written constitution to guide its sentiment nor yet to express its unity in words. Indeed were such a contract to be made it would probably defeat the object it had in view. Unity, loyalty and a harmonious family life come of the spirit and cannot be encompassed by statute.

The keystone of the British Empire is the Throne and so deep is the attachment that every citizen feels that he can turn to the Queen, the mother of the Empire, for succour in time of trouble or distress. How has this come about? The answer is a simple one. It has come about, as it does also in ordinary domestic life, by virtue of our respect and love for the head of the family.

We have been fortunate in our sovereigns and especially so in our beloved kings, George V and VI, father and son. These two men were regal in every sense of the word, but they needed no façade of pomp and circumstance to make them royal. Their lives were dedicated in the service of their great office yet they never lost the common touch. In their personal character and home life they set an ideal for all to follow. They knew and understood the common man, no matter what his creed or colour, they shared in his joys and sorrows and they spoke to him in his home. In like measure they gained a love and affection such as is usually reserved only for a beloved parent.

There can be no doubt that these two great and good men by their precept influenced the thoughts and actions of their subjects to a greater degree than any of their predecessors. Their tolerance, their supreme regard for right and wrong, and above all the great kindness of heart which was manifest in both, did more to strengthen the mystic bonds which unite the citizens of the Empire into one great family than did any other factor.

Queen Elizabeth II succeeds to a great and glorious heritage. She has shown already that she will be a worthy successor to her illustrious forebears. She comes to the Throne at a time when many of the old and well-tried ideas which guided the nation's life and actions so well in the past are in a state of flux. We are at the beginning of a new era, a time when the heaviest burdens and responsibilities will fall on those that are young in spirit and vigour. Our Queen is endowed well to fulfil her great task and destiny and lead the British Empire into a second glorious Elizabethan age.

God Save The Queen!

THE ROYAL FAMILY AND THEIR ANIMALS

THE great industrial revolution which was initiated when man learnt how to utilise the power of steam had far-reaching effects upon the basic economy of Britain and on our way of life. Agricultural and village England was transformed; the people flocked to the factories and, except for the pursuit of pleasure and relaxation, they knew the agricultural way of life no more. In spite of this, and as if by some inherited instinct, two things held an abiding place deep down in almost every heart: they were the land and the sea. It is this interest in the agrarian mode of life which has kept alive the ordinary man's great love for horse and hound and for the animals of the farm. It is through this also that the veterinary profession has made its closest contact with the members of the royal family.

The machine age has gone from strength to strength and the countryside has had to take second place, yet in the last 150 years great advances have been made in agricultural development, in arable farming, in horticulture, and especially in animal husbandry. This is due in no small measure to the efforts of the great landowners who have continued to take a deep interest in their estates, in the husbandry of the farm and in the welfare of all those who live by the land or animals. It is well known that a great landed estate, *per se*, does not offer the economic attraction to an owner or investor who seeks financial gain comparable with that yielded by industrial effort. As a rule, even on well-run properties revenue derived from other sources has to be used to sustain and replenish the hazardous economy of the field. We owe a great debt of gratitude to those who have continued to foster and stimulate the art and science of agriculture throughout all the baneful vicissitudes which have beset it from time to time.

Our kings and queens have set a noble example in this respect for they have taken a personal interest in their estates, their farms, their tenants and employees. The royal home farms have set a high standard for others to follow for they have been research centres for agricultural progress, and agricultural, veterinary and other societies and institutions have been honoured and encouraged by royal patronage. The royal animals have been exhibited in open competition at agricultural shows, and sometimes they have gained the highest award, while on other occasions they have taken second place to a tenant farmer's stock. This has provided a great stimulus and has encouraged a spirit of emulation. It has led to the production of better-quality stock and has helped to make Britain the premier nursery for the best-quality animals in the world.

Sport and agriculture are closely allied and especially so those sports associated with the cult of horse and hound. Racing and hunting owe much to royal interest. There are many who remember King Edward VII's great successes on the turf and King George V's prowess with the gun and the pleasure that he took in hacking in the Row, at Windsor and at Sandringham, while King George VI's interest in horse and hound was well known.

XUM

British people, with few exceptions, love their domestic pets. This devotion to a dumb friend causes amazement to foreigners. This traditional and instinctive love of the domestic pets is much in evidence in the Palaces. One cannot recall Queen Victoria or Queen Alexandra without thinking of their dogs, and the memory of King Edward's terrier " Cæsar " is still fresh in the minds of many. King George V and King George VI will ever be associated with those great gun dogs, the Labradors, and Queen Elizabeth II with the virile, cheery, affectionate Corgi.

It has been said that " It is the little things of life which matter," and indeed this is true, for a man's reaction to little things serves as a guide when we attempt to assess character. Men and women of high estate are judged not only by the greatness of their office but by their response to simple things of sentiment. A good man is one who can give and receive affection. Judged by these standards we have indeed been fortunate in our royal house.

Her Majesty Queen Elizabeth II

Her Majesty when, as Colonel-in-Chief of the Grenadier Guards, she attended her father, the late King George VI, on the occasion of Trooping the King's Colour of the 1st Battalion, Welsh Guards, in June, 1949.

The horse that Her Majesty is riding, " Winston," was purchased on behalf of the Mounted Branch of the Metropolitan Police from B. A. Cleminson, Esq., of Rawcliffe, York, in November, 1944, when he was seven years old. " Winston " is a chestnut gelding with a conjoined star and stripe, near fore and near hind heels white, and stands sixteen hands one and a half inches; he behaves with supreme reliability, dignity and poise on great occasions, while at other times performing, equally efficiently, the normal duties of a police horse.

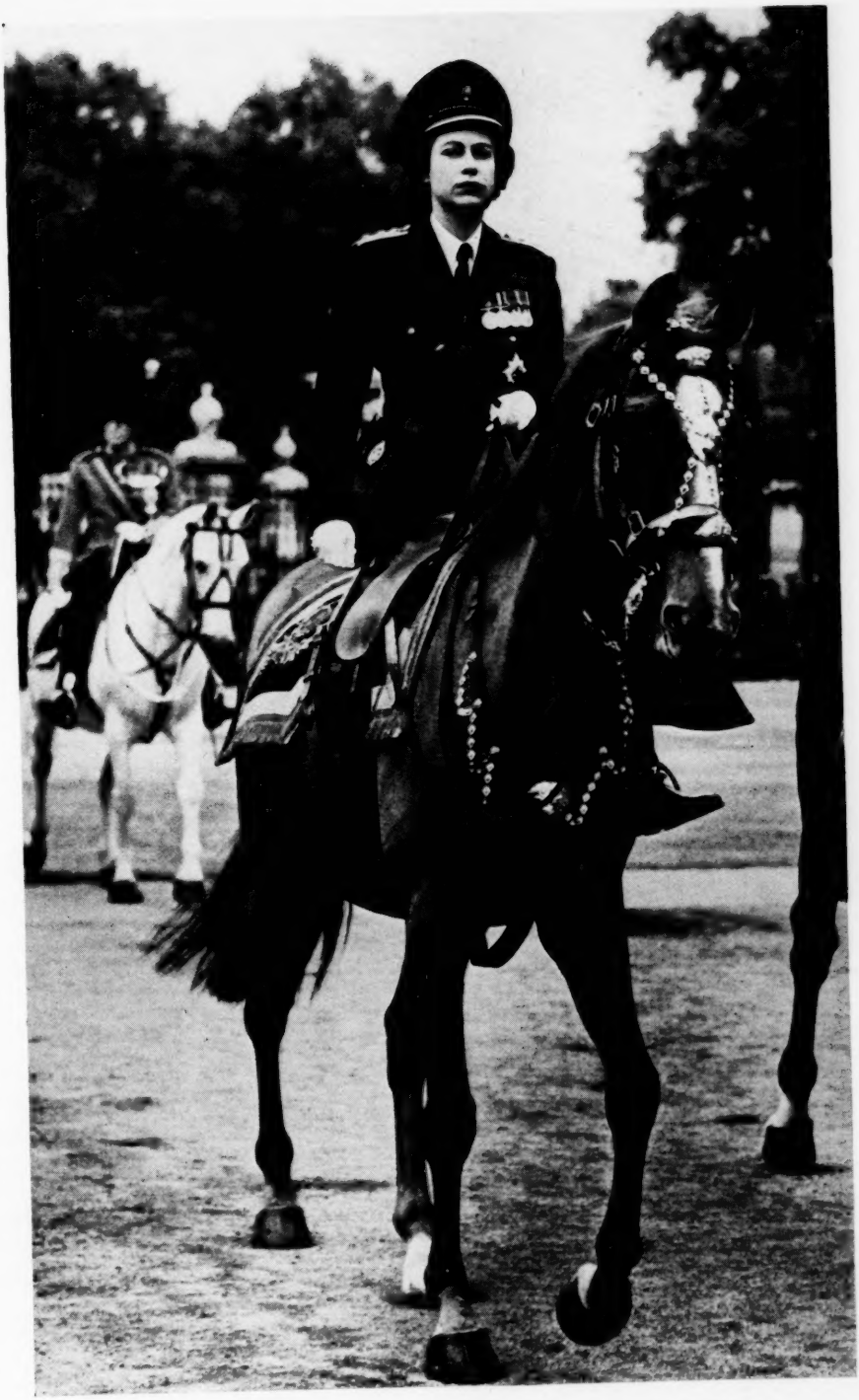

PHOTO : NORTHCLIFFE NEWSPAPERS

XUM

GENERAL ARTICLES

A BRIEF REVIEW OF THOSE ANIMAL DISEASES FOR WHICH LEGISLATIVE PROVISION IS MADE IN GREAT BRITAIN

By J. N. RITCHIE, B.Sc., M.R.C.V.S., D.V.S.M.
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GREAT BRITAIN is fortunate in maintaining a freedom from epizootic disease which is enjoyed by few countries. Comparatively few notifiable diseases remain as a problem. In addition to those already eliminated, parasitic mange of horses may now be added for the country has been free of this disease since 1948 when one outbreak occurred. Only one case of sheep scab was confirmed in 1952 (in February) and Scotland has had no case since 1941. There is therefore every prospect, especially with the availability of improved dips, that sheep scab may at last be eliminated.

A number of cases of rabies in dogs undergoing quarantine (26 since 1919) serves to remind us that it is only the strict enforcement of control of imports of livestock that saves us from reinfection with this disease and others.

After the widespread outbreaks during the war years, swine fever had been brought under such control, mainly by the absence of infective imported pig meats, that only five cases were confirmed in 1949. Since then there has been a recrudescence which has never assumed serious proportions but is nevertheless important to the pig producer at a time when expansion of the industry is needed to increase food production. Crystal violet vaccine is available and has proved of value but is not in heavy demand by farmers so long as disease is not an immediate threat to their herds. An increase in the use of this vaccine in breedings herds would be of great benefit in limiting the effects of the disease.

Outbreaks of anthrax had dropped to a very low level during the war due unquestionably to the reduction in imports of foreign feeding stuffs. The number of outbreaks in 1946 (95) was the lowest recorded since the Anthrax Order of 1910 came into force. Since then there has been a steady but not unexpected rise in the number of cases till July, 1952, when a sudden but sustained high level of confirmations was experienced. Only since December, 1952, has there been any diminution. The main feature of this series of outbreaks has been the frequency with which cases involving pigs have occurred. In 1952 the disease was confirmed in 559 pigs in contrast to the maximum of 59 in any previous year. This may be partly attributable to the lesser availability of home-grown foods and the extended use of imported protein feeds as supplements for pig feeding. To a much less extent the greater number of cases in pigs may be due to the difficulty in diagnosis of the disease in the pig compared with cattle and the fact that the examination of a wider range of material including not only blood and throat glands but peritoneal fluid has brought an increase in diagnosed cases.

XUM

Foot-and-mouth disease became a major problem in 1951-52, commencing with the more or less simultaneous appearance of infection in eastern coastal counties of England in November, arising, as we believe, through the agency of migratory birds from Europe. Later, outbreaks occurred in Southern England, Cheshire and neighbouring counties. From Cheshire disease spread to Scotland and the Midlands of England until a stage was reached when "controlled areas" covered most of the country.

The slaughter policy has been used in Great Britain to control foot-and-mouth disease since 1892 and has always succeeded in eradicating infection although severely tested in 1922-24, 1937-38 and again in 1942.

The recent outbreaks with their serious threat to the livestock industry were met with the determined application of the slaughter policy and its accompanying controls of movement of animals and sanitary measures. This vigorous policy proved itself once again but it only succeeded through a great effort by the Ministry's field staff sustained by the wholehearted support of the farming industry.

There has, however, been criticism of the policy and a committee is now sitting which is asked to "Review the policy and arrangements for dealing with foot-and-mouth disease in Great Britain, and to advise whether any changes should be made in the light of present scientific knowledge and the technique and administrative experience gained in recent years in this and other countries."

Fowl pest appeared only twice (in its acute form) prior to 1947. During that year numerous cases occurred and a system of notification and elimination by slaughter of infected and contact birds, movement control and sanitary measures brought it well under control. An extremely mild form of the disease has also been encountered and has been shown by survey tests to be of little real importance. Subacute cases have, however, continued to occur since 1949 and there has been considerable fluctuation in incidence, usually with a peak period in the winter months. The disease has been seen in England, Scotland and Wales but since 1951 has not appeared in Scotland and has only appeared in Wales because of introduction of infection with birds moved from infected flocks in England.

Infection has unquestionably reached this country in imported carcases—for virus has regularly been recovered from them. This source of infection has been removed since July, 1950, and though improvement in the position followed this ban on imports occasional acute cases have arisen from contact with swill from ships and with imported parakeets. However, recent experience suggests that foci of infection may be present in the country, confined to a few English counties and giving rise to outbreaks of subacute disease. It is planned to carry out survey tests in these areas in an endeavour to disclose any pockets of infection and allow infection to be cleared finally from the country.

Tuberculosis in cattle is being tackled realistically. During 1936, 23,716 animals were slaughtered under the Tuberculosis Order, 1935, the highest number killed in any one year; in 1952 only 2,831 animals were slaughtered. This notable fall arises from the efforts since 1935 to establish herds free of

infection. At the end of 1952 there were under the Tuberculosis Attested Herds Scheme 96,429 attested herds containing 40 per cent of the cattle population and a further 3,730 herds comprising 135,000 cattle only required one further clean test to become attested.

A plan for eradication of the disease from areas was launched in October, 1950. There are three stages, first the stage when free testing is offered to allow herd owners to bring their herds into the voluntary attested herds scheme; next the area is declared an eradication area when compulsory tests are made and all reactors in the area are slaughtered and compensation is paid; and finally, when all the herds have been cleared of infection the area is declared an attested area.

Three small attested areas comprising 14,000 cattle were declared in February, 1951; two large areas* which are now eradication areas will be declared very shortly and they contain 700,000 cattle. Two other areas containing 260,000 cattle are due to become eradication areas in January, 1954, and free testing areas with 825,000 cattle have been announced in March, 1953, to become eradication areas in 1955. Altogether one-fifth of all the cattle in the country are embraced in free testing, eradication and attested areas.

Contagious abortion has been brought very largely under control by the use of S.19 vaccine. In 1952, 370,000 animals were vaccinated under the Calfhood Vaccination Scheme, the highest in any year since the scheme started in December, 1944.

*Declared attested areas April 6, 1953.

DEVELOPMENT OF VETERINARY SERVICES IN NEW ZEALAND

By C. V. DAYUS, M.R.C.V.S.
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Before 1882, New Zealand had two primary exports, wool and wheat.

After the introduction of refrigeration the possibilities were immensely expanded for the export of livestock products such as meat, butter and cheese. The country underwent a change in economy following closer settlement, which, with the improvement of grassland and the use of artificial fertilisers, encouraged the development and expansion of the dairy industry and fat lamb production.

Livestock continued to increase, and to-day there are more than 35 million sheep and more than 5 million cattle in the Dominion. In addition, there are 4 million poultry and half a million pigs.

The need for improved animal husbandry methods and the organisation of meat inspection brought into being the Veterinary Services. The pioneering effort in both these projects stands to the credit of J. A. Gilruth, a graduate of the Glasgow Veterinary College, and a man of dynamic personality, who

XUM

arrived in New Zealand in 1893. Gilruth spent fifteen years in the country and laid the foundation of the Veterinary Division of the Department of Agriculture, a State organisation which celebrated its jubilee last year.

At the close of last century there were ten qualified veterinary surgeons in New Zealand, and in 1901 twenty-one were added to the Division; these were mainly for meat inspection work. During the next twenty years or so progress was slow, due to unattractive salaries, the predominance of quackery, and lack of public recognition of the value of veterinary services. The profession was, however, by no means idle and much spadework was done by Reakes and Reid. The new era had its beginning in 1926 with the passage of the Veterinary Surgeons Act, which established the Veterinary Surgeons Board. The Act provided for the registration of veterinary surgeons in New Zealand, a requirement for which Gilruth had fought years before. In these years the majority of the veterinary surgeons were in the Department of Agriculture. There were some private practitioners who were mainly confined to the cities, and to wealthier, more concentrated rural areas. The two Agricultural Colleges had a small veterinary staff who were engaged in teaching and extension work. In one or two instances groups of farmers had established clubs for the purpose of ensuring a veterinary service in their districts.

In 1939, with a view to better co-ordination of research into animal diseases and nutrition, the Animal Research Division was set up in the Department of Agriculture. Since the end of World War II this Division has expanded, and now has two very well-organised research institutions established at Wallaceville and Ruakura.

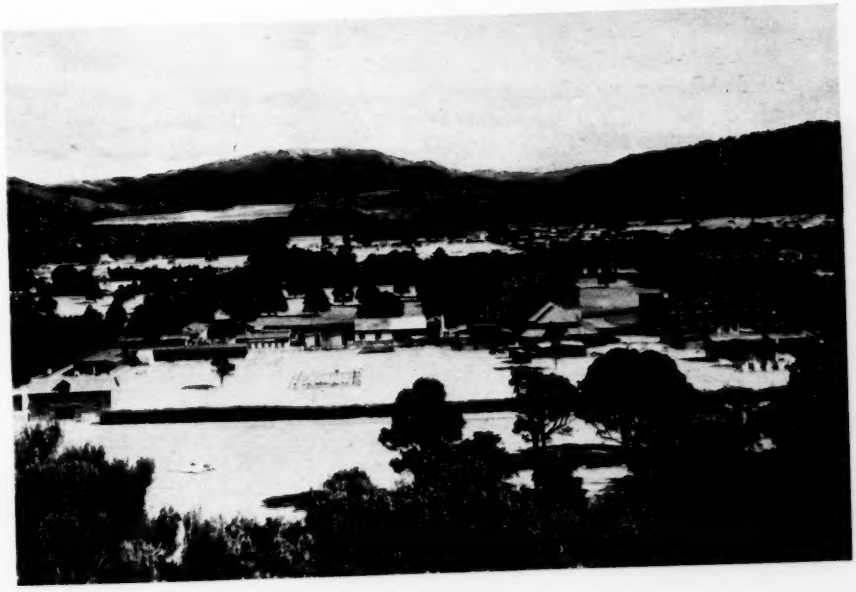
From 1939 onwards farmers and the public became increasingly conscious of the value of veterinary services and the need for their expansion. A new impetus was given to the establishment of veterinary clubs; a sufficient number had been established by 1943 to justify the formation of the Dominion Federation of Veterinary Services with the object of looking after the interests of the club movement.

The expansion of the club movement and increasing public recognition influenced the Government to set up a Veterinary Services Committee to report on the various matters required to effect an efficient veterinary service in New Zealand. At this time, 1943-44, the number of active veterinary surgeons in the Dominion was about seventy.

In 1946 the Veterinary Services Act was passed. This was an Act to make provision for the establishment and maintenance of veterinary services for farmers and for that purpose to constitute a Veterinary Services Council. The New Zealand Veterinary Association has one representative on this body and the veterinary clubs have two.

The Council has financial support from three Statutory Primary Producers Boards, viz., Dairy, Meat and Wool, to which is added an equal contribution by the Government, thereby making the annual revenue up to a maximum of £100,000.

Due largely to the expansion of the veterinary club movement, the number



(*Article by Dayus, page* 219)

XUM

of active veterinary surgeons in New Zealand has substantially increased and at the end of 1951 there were more than two hundred. Since then the number has increased.

In the early 1920's, the New Zealand Veterinary Association began in a modest way. It became affiliated to the National Veterinary Medical Association (now the British Veterinary Association) and is now a very live body. In 1952 it published its first independent organ, the *New Zealand Veterinary Journal.*

This covers briefly the development of veterinary services in New Zealand since Gilruth's advent sixty years ago. Much more may be expected in the future, for nowhere, as far as I am aware, is the profession more actively concerned with questions of environment. Whether in administration, research, extension services or practice, its thoughts are increasingly towards populations rather than of individuals, and of prevention rather than cure. Referring to the incalculable value of maintaining a high standard of animal health and paying tribute to the veterinary services, Viscount Bledisloe, then Governor-General of the Dominion, in 1934 said: "This is of especial importance in a country like New Zealand, whose economic welfare—indeed, whose economic existence—is predominantly interwoven with her pastoral industry, which in turn depends for its well-being upon the health and vigour of its livestock and their fitness for the commercial requirements expected of them."

VETERINARY EDUCATION IN CANADA

By THOMAS W. M. CAMERON, M.A., D.Sc., M.R.C.V.S.
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VETERINARY education in Canada had its formal beginning in 1864 when Andrew Smith, with the temporary assistance of Duncan McEachran (both graduates of the Dick Veterinary College), commenced teaching in Toronto, Upper Canada. The association lasted only three months. Smith stayed in Toronto; McEachran went to Montreal, Lower Canada, where, the following year, he founded his own college. Both were outstanding men with strong personalities and widely divergent views on education, and it was impossible for them to have worked together for any length of time. Smith was a practical man whose interests were with the veterinary art rather than the science, although he emphatically did not disregard science and employed some excellent teachers. He was also, however, a politician and circumstances in Toronto had much to do with the early history of the school which he founded. He had to make his own school, without public support and to depend mainly on fees for its private support. In consequence, he had to concentrate on numbers rather than quality and admit all who could pay the fees, regardless of scholarship.

McEachran, who was seven years younger than Smith, had not only a more scientific point of view but a much sounder appreciation of pre-veterinary

XUM

requirements. Moreover, he was much less of a politician and, unfortunately, rather deficient in diplomacy. His college at Montreal demanded the same standard of education for admission as did the medical school at McGill (then the leading medical school in North America) and it shortly became a faculty of the University—the Faculty of Comparative Medicine and Veterinary Science. Many of the classes of both medical faculties were taught by the same people—among others, Sir William Osler, who signed himself: "Lecturer in Helminthology at the Montreal Veterinary College," and the Principal, Sir William Dawson, who taught biology. McEachran was undoubtedly one of the foremost veterinarians of his day—one might say of any day. He set a high standard for his students—too high for his time, perhaps, and certainly too high for the financial success of his school so that, although McGill was a privately-endowed university, the school had to be discontinued in 1902 for lack of financial support and because of competition of schools of lesser standing. However, it left an ideal which has taken the Dominion many years to reach. In the Montreal school there developed a French-speaking branch which, after many efforts and not a few failures, crystallised as the present Quebec Veterinary Collge, just as from Andrew Smith's College grew the Ontario Veterinary College.

Although each of the ten Provinces of Canada controls its own veterinary matters and sets its own standards of proficiency, these are the only two schools at present in the Dominion—one in Ontario, an English-speaking one which serves two-thirds of the over fourteen million Canadians; the other in Quebec, a French-speaking one which serves the remaining third.

These two schools are the survivals of a considerable number of predecessors. They have had many vicissitudes in the past but their future seems well assured. However, in both McEachran's ideas have ultimately prevailed.

The Ontario Veterinary College is under the Department of Agriculture of Ontario and is affiliated with the University of Toronto. It is situated at Guelph, 50 miles west of the city, in buildings which have recently been greatly enlarged and re-equipped. Admission is on the senior matriculation standard, as for the rest of the University, and the student undergoes a five-year course of instruction at the successful conclusion of which he receives the degree of D.V.M. from the University. The College operates in association with the Ontario Agricultural College so that some physical facilities are held in common and there can be some exchange in teachers between the Faculties.

The curriculum follows well-established lines. Before admission a student, in addition to possessing the necessary academic qualifications, has to produce evidence of at least four months' experience with livestock and be of good physical health. Term begins in October and extends to mid-May each year. In the first year, pre-medical subjects are studied; in the second, anatomy and physiology; in the third, the pathological subjects and nutrition, and an introduction to clinical work are given. In the fourth year the emphasis is on disease and this emphasis becomes increasingly more clinical in the fifth year. However, the fifth year is not really separate from the fourth as a compulsory

XUM

four months' internship joins them. The total study time accordingly occupies about 180 weeks' instruction at the College. Annual fees for all British subjects are $100 and for foreigners $300.

The College buildings are well equipped, the staff well trained, and the curriculum well balanced. Under the impetus given to the training by the late Dr. A. L. MacNab and the present Principal, Dr. T. Lloyd Jones, the Ontario Veterinary College compares favourably with the best in the Commonwealth.

Graduates may proceed to advanced degrees at the University of Toronto, e.g., M.V.Sc., after two years' postgraduate advanced study and research, and to D.V.Sc. after at least three years at the University following graduation or six years elsewhere. The University also provides a one-year's course leading to a Diploma in Veterinary Public Health; the Diploma is available to graduate veterinarians in general.

The McGill Faculty of Comparative Medicine and Veterinary Science no longer exists but the University, in common with most other Canadian universities, offers facilities to graduate veterinarians (not necessarily Canadian) for postgraduate training in the fundamental sciences. In particular, McGill has facilities for studying for the M.Sc. or Ph.D. in a considerable number of departments — perhaps most especially in Bacteriology, Nutrition and Parasitology. Instruction for these degrees requires a minimum of one and three years, respectively, after graduation.

The Ecole de Médecine Vétérinaire is situated at Ste. Hyacinthe, some 35 miles from Montreal (the second largest French-speaking city in the world). It is affiliated with the Université de Montréal which grants a degree of D.M.V. at the successful completion of a five-year course—one year pre-veterinary followed by four years of professional instruction, which parallels quite closely that of the Ontario school. Tuition is in French and the school is attracting students from Latin America as well as the French-speaking parts of Canada.

The school has only recently moved to Ste. Hyacinthe and is at present in temporary quarters. However, under the energetic supervision of the Director, Dr. Gustave Labelle, splendid new buildings are being constructed by the Quebec Department of Agriculture which promises to provide facilities comparable to the Ontario school. As the school is maintained by the Provincial Government, tuition fees are low—$5.00 annually for residents of Quebec, $100 for other Canadians, and $200 for non-Canadians.

Veterinary Research

Research is, of course, a function of both schools and the authorities of both recognise the value of research *per se,* and its value in education. It is also a function of Government and both the Dominion and the Provincial Governments take an active interest in research in general. The largest single centre is the Animal Diseases Research Institute at Hull, P.Q., maintained by the Dominion Department of Agriculture and under the active directorship of Dr. Chas. A. Mitchell, A.R.C.V.S. However, also under his direction are a

number of local divisions, concerned partly with diagnosis, partly with local problems; Canada is too large a country with too many varying climates and problems to have all its research centralised. In addition, many Provincial Governments have local research stations, usually working in close association with the universities. Although there is no formal control of these by the Dominion, a considerable degree of co-ordination is maintained between them all. In addition to these more specifically veterinary facilities for research, others of a less definite veterinary nature occur both in the Dominion Government and in the Universities. Thus, in the Science Service of the Dominion Department of Agriculture there is a large and well-organised Division of Entomology, which has an important section dealing with arthropods affecting man and livestock. There is also an elaborate system of experimental farms which carry out much practical research of considerable veterinary interest. Other Divisions are concerned with breeding, nutrition and similar fundamental subjects.

Similar more or less fundamental research work of veterinary importance is carried out at the numerous faculties of agriculture at the universities and at such provincial institutions as the Ontario Research Foundation. Some of these departments, or combinations of departments, are outstanding research centres not only in Canada but in North America. Many of them also receive financial assistance from the National Research Council of Canada. This is a Department of the Dominion Government which is controlled by a special committee of the Privy Council. The Research Council is an elective body—mostly of outstanding scientists in the Universities—with a permanent President. It possesses its own laboratories, not only a main set in Ottawa but a series of regional ones in other parts of Canada. These laboratories, *inter alia,* have a Division of Applied Biology, under Dr. W. H. Cook, which carries out research which in many ways is fundamental to veterinary science. However, the Council also distributes large sums in annual grants as " assisted researches " to qualified individuals in the Universities, to enable professors and others there to conduct, in both the biological and physical sciences, investigations which would otherwise be impractical; it also provides numerous scholarships and fellowships to train young scientists.

The Institute of Parasitology of McGill University, situated at Macdonald College, is basically financed by the Council (although it is an integral department of the University) and a considerable part of its research is devoted to the more fundamental aspects of veterinary parasitology. It works in close association with the Dominion Department of Agriculture and the Dominion Department of National Health and Welfare, and its interests extend to parasites not only of farm animals but of man, of wild life and of fish—some of which are of great veterinary importance. Its work, however, is tending to become more and more fundamental—particularly in the fields of the physiology and biochemistry of parasites, leaving to its extramural associates the more practical applications of the science. The Institute was founded over 20 years ago to help serve parasitology in the more temperate regions of the Commonwealth,

and during this period it has had transient assistants from almost every Commonwealth country while its present staff have their origins in Great Britain, Canada, Australia and New Zealand, as well as in the United States.

Veterinary Practice

Under the British North America Act, each Province in Canada controls its own veterinarians and no one can practice who is not a member of the Provincial Association. Naturally, conditions in each Province vary and this has led in the past to considerable differences in standards. However, this is rapidly being rectified and the creation a few years ago of a Canadian Veterinary Medical Association will undoubtedly help to maintain the high standards now being set by the schools. The Association has no legal authority to interfere with either education or practice, but as almost all qualified veterinarians in the Dominion are members it has considerable influence. This influence is augmented by the central character of the *Canadian Journal of Comparative Medicine and Veterinary Science* (named after McEachran's old faculty) which is published monthly and is now in its seventeenth year of publication.

Although the Dominion as such has no say in either education or practice, it employs a considerable number of veterinarians as inspectors and administrators in the control of contagious diseases of livestock and in meat inspection.

The Future

There is no way of forecasting the future. The horse is becoming of minor importance but other farm livestock are on the increase. Canada has probably greater opportunities for both material and cultural development than any other country in the world. Its vast sub-Arctic and Arctic regions are being quickly and efficiently opened up. Its commerce and export trades are increasing and its standard of living is rising. There is no doubt that an increased demand for veterinary services and veterinary research will ensue. What directions it will take is less clear. New diseases can be expected from the North. New and hardier strains of animals will be in demand. Probably breeding and nutrition will be as important in research as are pathology and the agents of infective disease. The standard of veterinary education will, if the present tendencies continue, not only be maintained but be raised. The vast size of the country and the relatively small population make some kind of subsidy system necessary adequately to compensate the well-trained veterinarian for the distances he has to travel between cases. Already steps have been taken by some to install two-way wireless in their cars to help save time between visits. Cars may be replaced by faster means of transport and the disadvantages of great distances will be minimised; the population will steadily increase and subsidies gradually become unnecessary. The general future is good even although the actual details of development are still obscure.

One development which the writer would like to see is the adoption of a uniform standard of veterinary education throughout the entire Commonwealth.

XUM

The profession is a small one and must for some time to come remain small. Its standards everywhere have gradually but steadily increased until they are now—in the Anglo-saxon countries at least—at a level which commands the respect of everyone. A Commonwealth Confederation would strengthen and consolidate these and such a Confederation on a real democratic basis might well be one of the early objectives of the new Elizabethan era.

BOVINE STERILITY CAUSED BY INFECTIOUS DISEASE IN SOUTH AFRICA

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"Ex Africa semper aliquid novi." To no other sphere of life and conditions in Africa does this dictum apply more forcibly than to the great variety of animal diseases which has provided such a severe handicap to animal breeding on this continent during the past half-century.

Epidemic and endemic protozoal, bacterial and virus diseases have perhaps overshadowed other categories in the past. The losses resulting from these are, however, being rapidly reduced by new and improved methods of preventive inoculation, by more effective curative treatment with specific drugs, and by successful elimination of the transmitting insects and intermediate hosts.

On the other hand, those concerned with the production and improvement of livestock view with growing alarm the increasing number of factors which produce temporary or permanent sterility in animals, thus producing another serious obstacle to breeding. Among these the various forms of infectious infertility form the most important economic group.

There is an unfortunate tendency in the literature to designate certain specific forms of infertility by terms that are vague and confusing, such as "infectious sterility" and "enzootic sterility." Such indefinite nomenclature should be discarded in favour of names that will indicate either the causal organism or the principal lesions.

Infectious diseases associated with sterility are not confined to those that are essentially venereal in nature, but include a number of general infections which produce secondary lesions in the genitalia, thereby causing temporary or permanent sterility; these conditions should be included in any survey of infertility.

In addition to those diseases that impair breeding in other countries, Africa has several new conditions that have not yet been observed elsewhere, and some of these constitute great problems in animal breeding.

Brucellosis

Contagious abortion is extremely prevalent in dairy and ranching herds throughout the country. It is not, however, a condition which is causing serious concern to the worker on sterility, since there is available a method of diagnosis whereby the presence or absence of the disease in any herd can be established with certainty. Furthermore, strain 19 vaccine offers an effective method of control.

Bovine Tuberculosis

While great strides are being made in the control and eradication of some tropical diseases, the same progress cannot be claimed for the diseases of domestication. Bovine tuberculosis is increasing in an insidious manner, particularly amongst dairy stock, and at a rate which is causing grave concern.

This disease is not primarily regarded as an important factor in the causation of sterility, but the high incidence of tuberculous metritis and salpingitis in infected herds justifies its inclusion among the ætiological factors of sterility. Quinlan (1929) states that tuberculosis of the uterus frequently occurs with tuberculous lesions in the peritoneum and lungs in cattle, and he found it in 18 per cent of the tuberculous cows destroyed during his investigations into bovine sterility in South Africa. Canham (1937) reports eleven cases of abortion due to tuberculosis in a pedigree dairy herd.

No active tuberculosis eradication campaign has as yet been initiated in this country, and no inducement of any kind is offered to the dairy farmer to encourage the eradication of the disease. Under these circumstances it will continue to spread and tuberculous metritis will play an increasingly important role in the causation of infertility in dairy herds.

Lumpy Skin Disease

This is an acute infectious disease characterised by the eruption of cutaneous nodules and by marked swelling of the superficial lymph glands. It may be accompanied by a secondary infection resulting in the formation of nodules or inflammatory lesions in the internal organs including the genitalia. The nodules in the skin may persist and become indurated or necrotic, exposing deep-seated ulcerating sores. In cows, nodules or small circumscribed abscesses may occur in the uterine wall, resulting in abortion or sterility. In the bull the scrotum and testes are frequently affected severely, and there may be lesions on the inner surface of the prepuce and on the glans penis. Other likely sequelæ are atrophy of the testes and orchitis, resulting in oligospermia or aspermia. These involvements of the genital organs usually produce sterility.

The disease is limited to Africa and was first described by McDonald in 1931 in Northern Rhodesia. It was noted in the Transvaal in 1944, and in the subsequent two years it spread throughout the Union as a severe epidemic. In 1946 the total number of outbreaks in the Union was 8,154.

Direct losses from lumpy skin disease are small, but it is a disease of economic importance on account of the unfavourable sequelæ such as sterility, emaciation, decreased milk yield and slow recovery.

XUM

Although all breeds of cattle are susceptible, highly bred pedigree stock suffer most severely, and during the 1944-46 epidemic many valuable dairy and beef animals were rendered permanently sterile. No satisfactory cure or preventive for the disease is known.

Globidiosis

This disease occurs in different classes of animals but it is believed that each species has its own specific parasite, cattle being affected by *Globidium besnoiti*. The method of infection and transmission is not yet known, neither is a reliable cure or preventive available.

The causal organism produces numerous spherical cysts up to 5 mm. in diameter in the skin and subcutis, and these give rise to scleroderma, elephantiasis, loss of hair, and emaciation.

In bulls, the cysts show a tendency to penetrate into the deeper structures in the scrotum and inguinal canal and to invade the stroma of the testes, epididymis and the pampiniform plexus, where they persist and eventually become calcified, thereby causing sterility.

Although the presence of globidiosis in cattle in South Africa was only recorded for the first time by Hofmeyr in 1945, it is spreading rapidly in the bushveld areas of the Transvaal, which form the best beef-producing portion of the Union.

While the reproductive organs of the cow do not appear to be affected, the frequent involvement of the male genitalia provides a serious threat to breeding, since farmers in the affected areas are becoming reluctant to purchase good bulls when their reproductive life is liable to be terminated at an early age by globidiosis.

Trichomoniasis

Robinson (1937) was the first to record a case of trichomoniasis in South Africa. This was in a heifer that aborted at Onderstepoort, and its origin could not be traced. It has since been diagnosed in herds in different parts of the country and it appears to be fairly widespread.

The report of the Director of Veterinary Services, Southern Rhodesia, for 1948 mentions a case of trichomoniasis in a heifer imported from England. This was diagnosed while the heifer was in quarantine. That this disease is also present in Kenya is evident from the annual report of the Veterinary Department for 1944, which records the existence of trichomoniasis in the Limuru area.

Notwithstanding its wide distribution, trichomoniasis is not at present regarded as a very serious breeding problem, mainly because it appears to be self-limiting, and by comparison with some of the other venereal diseases of Africa its harmful influence on breeding is not pronounced.

Vibriosis

Abortion in cattle due to *Vibrio fœtus* infection was first reported in South Africa by Snyman (1931), who then expressed the opinion that " the infection

is more widely spread and causes more abortion than is generally accepted." Canham (1948) investigated a number of outbreaks of bovine abortion in Natal and identified *Vibrio fœtus* as the cause in every case. He, too, concluded that vibrionic abortion is very prevalent in Natal and other parts of South Africa. Subsequent investigations into herd infertility have confirmed the view that *Vibrio fœtus* infection is fairly extensive in the Union.

It is significant that the two authorities cited, as well as all other earlier workers in Europe and America, have only referred to *Vibrio fœtus* as a cause of abortion. Henning (1949), for instance, states: "The only symptoms manifested are those associated with abortion, and the affected female does not suffer any other clinical disturbance." Plastridge, Williams and Petrie (1947) were the first to point out that lowered conception rate might be found in infected herds. The role that *Vibrio fœtus* plays in the causation of bovine infertility, apart from abortion, has, however, only received prominence since Stegenga and Terpstra (1949) established that this organism is the cause of "enzootic sterility" in Holland. Consequently, the former name "vibrionic abortion" is now rapidly being replaced by "vibriosis" and "*Vibrio fœtus* infection."

This receives further consideration in the discussion on anterior vagino-cervicitis.

Contagious Granular Vaginitis

After having enjoyed popularity as one of the principal causes of infertility, granular vaginitis has been relegated to obscurity and is seldom heard of nowadays. It is certain that the importance of this disease was grossly exaggerated and that it was frequently blamed for sterility produced by one of the other types of coital infections.

Granular vaginitis has provided nostrum vendors with an opportunity for marketing their wares, and in South Africa more cows have been rendered sterile by the treatment applied by the owners than by the disease itself. Quinlan (1929) frequently found stenosis of the vagina in herds in which irrational treatment for vaginitis or retained placenta had been carried out, and this has also been the experience of many other veterinarians.

Contagious Epididymitis and Vaginitis ("Epivag") in Cattle

This is a contagious venereal disease characterised by induration and enlargement of the epididymis in bulls and by inflammation of the anterior vagina and of the vaginal portion of the cervix in cows. It is the most important cause of bovine infertility and the greatest menace to cattle breeding in the African sub-continent.

The different aspects of the disease have been described by Daubney, Hudson and Anderson (1938), and by Hudson (1949), while Anderson (1951) has given a complete account of the changes observed in the semen of affected bulls.

XUM

As far as is known this condition is prevalent only in Africa, but Capobianco (1949) has described a contagious form of epididymitis in Italy, which gives rise to characteristic lesions in the genital tract in both sexes. It is possibly the same disease, which has infiltrated into Southern Europe.

The disease was recognised in Kenya for the first time in 1927, but it was probably endemic in the indigenous breeds before that, and the introduction of susceptible European breeds revealed its presence. According to the report of the Director of Veterinary Research, Southern Rhodesia, for 1944 it was prevalent in Rhodesia in that year, and its presence in the Union was first reported by van Rensburg (1949). That it was not a recent introduction is shown by the fact that a year's survey which followed its diagnosis showed that more than 400 herds in the Transvaal, 3 in Natal and 19 in the northern portion of the Orange Free State were infected. It appears to be limited to the northern half of the Union and no cases have as yet been observed in the south, i.e., the Cape Province and Southern Free State.

In the Transvaal the disease has been found in both sexes in all breeds, including native cattle, but it is quite evident that the indigenous types are far more resistant than exogenous breeds. The virulence of the infection, too, may show marked variations within the same breed, and it is easily influenced by environmental, climatic and nutritional factors. In one highly bred Friesian herd all four bulls were rendered sterile and the majority of cows became diseased within eight months after introduction of the infection. Apart from infertility, these animals showed a marked loss of condition and a 70 per cent reduction in milk yield. In another herd a Friesian bull only developed epididymitis after he had been serving infected cows for eighteen months.

Bulls also appear to have an individual resistance or predisposition. A certain Friesian herd became infected in 1950, with the result that one of the two herd bulls was sterile within three months while the other is still serving well and is fully fertile after three years.

Although epididymitis is the characteristic lesion in the bull, cases have been encountered in which both epididymides are normal but one or both vesiculæ seminales show a severe vesiculitis with pus in the semen.

In many herds most cows conceive again after a six- to eight-month period of sexual rest. In fact, many cows become pregnant to natural service or artificial insemination as soon as the acute stage of vaginitis has passed, and while still showing a muco-purulent vaginal discharge. The latter ceases during pregnancy and most of the cows usually calve normally. It is characteristic of "epivag" that abortion rarely if ever occurs. These cows may, however, show a severe recrudescence of cervico-vaginitis with a copious discharge after calving.

The wisdom of attempting to breed from animals while they are still showing evidence of active infection is open to question. This may account for the unusually large number of cases of apparent death and resorption of the fœtus which occur in infected herds. There is also a suspicion that it may open the way for a forward spread of the infection, resulting in the unfavourable sequelæ such as metritis, salpingitis, pavilionitis and peritonitis which render a

XUM

large proportion of affected cows permanently sterile, the incidence of these complications being as high as 50 per cent in some herds.

Transmission of infection is primarily by coitus. In infected herds, however, typical lesions have been seen in heifer calves of about three months old and before the initiation of the sexual cycle. This suggests mechanical transmission by such agencies as insects and infected floors and bedding. As far as the male is concerned, no case of epididymitis has as yet been recorded in a bull that has not served naturally.

All available evidence points to a virus as the cause (Daubney, Hudson and Anderson, 1938). From material obtained from cattle showing vaginitis, Haig and McIntosh (1953) have isolated a virus which can be propagated both in embryonated hen's eggs and in white mice. The size of this agent has been estimated by gradocol membrane filtration as being rather less than 100$\mu\mu$. Early mouse and egg passage suspensions have produced mild cases of vaginitis when introduced into the vagina of heifers. From one of these cases the virus was re-isolated in mice from blood obtained during a mild febrile reaction on the fifth day.

By means of neutralisation tests it has been found that a large number of cattle in South Africa possess antibodies against this agent. As a result it has been difficult to evaluate the significance of these antibodies in those herds in which a clinical diagnosis of "epivag" has been made. Most recent work by Haig and McIntosh (1953) suggests that this virus may be associated with contagious anterior vagino-cervicitis rather than with "epivag."

Contagious Anterior Vagino-cervicitis

When the presence of "epivag" in the Union was established in 1949 this condition was immediately declared a notifiable disease under the Stock Diseases Act, and a survey was instituted to determine its extent in the Union.

In the absence of a specific test, diagnosis had to be based on a clinical examination of both bulls and cows. Veterinarians and inspectors engaged on this work were advised not to make a positive diagnosis unless they found the two characteristic lesions in the same herd—namely, a purulent anterior vaginitis in the cow and epididymitis in the bull.

The campaign had not been in progress long when these officers experienced great difficulty in that they found many herds in which the cows showed a typical anterior vaginitis and cervicitis, while no lesions could be detected in the bulls. At that time it was considered that these were actually cases of "epivag" and that in due course the bulls would show lesions. This presumption proved to be erroneous. Furthermore, observations made while examining numerous herds for sterility in all parts of the Union during the past three years have convinced us that we have an additional coital infection similar in many respects to "epivag," and yet presenting features that are different.

The cardinal symptoms seen in affected cows are the same in the two types—namely, vagino-cervicitis with a creamy-white, opaque, odourless and extremely tenacious muco-purulent discharge. In the latter disease, however,

XUM

the inflammation is not as severe and subsides more quickly than in " epivag." The pus is less and is frequently observed on the floor of the anterior vagina only or oozing from the vaginal wall and the cervix. It is more copious within the first week after service by an infected bull. There is not the same tendency for the infection to spread forward producing the undesirable sequelæ and permanent sterility as in " epivag."

The incubation period is less than 24 hours in both natural and artificially produced cases, whereas in " epivag " it is at least four days in natural and two to four days in experimental cases.

This form of anterior vagino-cervicitis is not confined to the " epivag " area but has been seen in various districts throughout the Union. Transmission is by natural service by an infected bull or by insemination with semen from such a bull. The symptoms can be produced within a few hours by inseminating a clean cow or heifer at any stage of œstrus or diœstrus with semen from an infected bull.

While the bull appears to harbour the infection for an indefinite period, no macroscopic lesions are produced in any part of his genital tract, and his fertility does not appear to be impaired. In three bulls, however, an unusually rapid deterioration in the quality of the semen was noticed if they were worked too frequently.

While most bulls become infected by serving diseased cows, there is strong evidence to suggest that infection may be pre-natal or neo-natal. Several cases have been observed in which bull calves born in infected herds have transmitted infection to clean cows and heifers at their first service. This aspect is now being investigated further.

Apart from its close resemblance to " epivag," this type of infectious sterility presents a syndrome which is not unlike that seen in *Vibrio fœtus* infection. This organism has been removed from some of the affected herds, although in most herds the recognised tests have failed to detect *Vibrio fœtus*.

In the majority of affected herds abortion is not a marked feature or may be completely absent, and it is usually the infertility that causes the owner to seek veterinary assistance.

The indications at present are of the possibility of a double infection of both *Vibrio fœtus* and an unknown virus being present simultaneously in many of the herds; these two agents may be synergistic.

Control by means of Artificial Insemination

The control and eradication of the infectious diseases associated with infertility are greatly handicapped by the following factors:—

(1) With the exception of tuberculosis and brucellosis, there is no reliable diagnostic test for any of them;

(2) No method of preventive inoculation is available for any except brucellosis;

(3) No specific or satisfactory cure is known for any of these diseases;

(4) Any one of the infections may be present in a latent form, giving no indication of its presence to a prospective buyer; and

(5) Many otherwise honest farmers appear to abandon all scruples when they suspect infertility in their herds and do not hesitate to offer the affected animals for sale to unsuspecting buyers. This is the most frequent method whereby the various types of infection are brought into clean herds.

Under these circumstances artificial insemination affords the only practical method for the control of the various venereal diseases. Kenya was one of the first countries in the world to institute artificial insemination on a big scale, and the introduction of this method of breeding into Africa closely followed the detection of "epivag." Rhodesia and the Union benefited from Kenya's experience and also adopted artificial insemination for the control of "epivag" as soon as it was diagnosed in these territories.

In Kenya and Rhodesia artificial insemination services are provided by the State, but in the Union the severe financial burden imposed by the inevitable heavy capital expenditure and high maintenance costs has to be borne by the stock-owners themselves, the State assisting only in granting technical advice. Three farmers' co-operative societies supply artificial insemination services, and at present they inseminate about 20,000 cows per annum. The result has been a remarkable improvement in the dairy herds, especially in "epivag" areas, where milk production has been trebled in some of the old infected herds. In the ranching areas artificial insemination has increased the conception rate in some of the beef herds from 30 per cent to more than 80 per cent.

It is obvious that in a country riddled with infectious coital disease the strictest control must be exercised over bulls supplying semen. This supervision is carried out by the Division of Veterinary Services. Bulls are not licensed for artificial insemination service until they have passed a severe clinical examination and all the recognised tests for infectious diseases, as well as the tests for semen quality. In addition, the semen of every new bull is first injected into the anterior vagina and cervix of a number of clean heifers, and these are kept under close observation for two weeks to ensure that no vaginitis and cervicitis with pus formation are produced. This method of testing has proved remarkably efficient, as is shown by the fact that of the many thousands of cows inseminated during the past three years not one has picked up infection of any type from the semen.

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XUM

THE PRODUCTION AND USE OF A *BRUCELLA ABORTUS*, STRAIN 19, DESICCATED VACCINE IN NIGERIA

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BRUCELLA ABORTUS infection of cattle in Nigeria is of importance only in herds on Government farms, where it is necessary for animals to be housed in close proximity and to be grazed on relatively restricted areas. Under these conditions the incidence of brucellosis may be as high as 30 per cent as indicated by reactors to the agglutination test.

In herds owned by Africans, especially in the Northern Provinces, where the majority of owners are nomadic Fulani, a survey showed a reactor rate of 0.1-0.25 per cent. Abortion is known to occur in these herds but it is thought that such factors as malnutrition and trypanosomiasis are of more importance than brucellosis. It is unlikely that brucellosis could spread easily among these herds owing to the methods of management.

Attempts at eradicating the disease on Government farms by the slaughter of reactors and by strict methods of hygiene proved ineffective, breeding programmes being upset seriously in some cases. In 1945, *Brucella abortus*, Strain 19, vaccine, was first produced at the Vom Laboratory and was used extensively on Government farms in Nigeria and the Cameroons. This vaccine was similar to that used in the United Kingdom with the exception that, following the work of Campbell and Rodwell (1945), the dose given was 0.2 ml. intradermally. It became obvious from the results of post-vaccination agglutination tests that the vaccine was not producing the results in the field expected from previous laboratory trials. Mettam (1948) stated that the titres of sera from vaccinated animals were disappointingly low. In many cases there was no response to vaccination. This was attributed to the conditions under which it was necessary to transport the vaccine to the field.

Love and Mingle (1942) considered that the adverse influence of temperature variations on the viability of fluid Strain 19 vaccine was very marked. Mitchell and Moore (1942) reported that agitation had a similar adverse effect. Dalling (1948) emphasised the ill-effects of both factors. During the transport of vaccine by rail or over rough roads in Nigeria both temperature increases and agitation are liable to be excessive. As long as there are no unduly long delays in transit the temperature can be controlled by the use of ice and thermos jars but it is not possible to prevent the agitation of a fluid vaccine.

It seemed that a desiccated vaccine would aid materially in mitigating the effects of temperature increases and would rule out agitation as a factor of any importance. Verwey (1945), Verwey and Scheidy (1946) and Scheidy (1947) described a lyophilised Strain 19 vaccine. Essentially, it consisted of a suspension of Strain 19 organisms in saline buffered at *pH* 6.8 with a phosphate buffer. To this suspension was added an equal quantity of skimmed milk. It was found that the number of organisms surviving desiccation in this medium

was rather more than 50 per cent and was considerably greater than in a gelatin medium. In bovine serum relatively satisfactory survival rates were obtained but the product was not so stable on storage.

Proom and Hemmons (1949), reporting on the maintenance of a large collection of stock cultures as desiccates, showed the necessity for the presence of a protective colloid in the suspending medium, saline proving unsuitable for most organisms. They also showed that exposure of desiccated *Br. abortus* cultures to a temperature of 60° C. for one hour resulted in an 18 per cent loss of viability. At 80° C. the loss was 71 per cent. Verwey (1945) showed that Strain 19 desiccated vaccine, sealed in vacuo, was stable at room temperature for at least three years. Stability following constant exposure at approximately 38° C. was less than at room temperature. Atmospheric temperatures higher than 38° C. are encountered in Nigeria and the necessity for some protection of a desiccated vaccine is indicated.

Verwey and Matt (1950) reported that desiccation did not cause any physiological damage to the surviving organisms in Strain 19 vaccine. Greaves (1950) and Fry and Greaves (1951) considered that the number of surviving organisms might be affected adversely by over desiccation. They showed that the addition of sugars, such as sucrose, glucose or lactose, to the suspending medium greatly increased the survival rate of a paracolon organism by preventing the removal of the last traces of water.

It was also necessary to consider the dose and the route of inoculation, the intradermal route having proved unsatisfactory when used by African field assistants, the 0.2 ml. dose being deposited subcutaneously or, if the injection was into the dermis, it was carried out in such a manner that there was a considerable backflow of vaccine along the needle track. The possibilities of the intracaudal route as described by Campbell and Rodwell (1945) and McDiarmid (1950) were investigated. From these reports it could be assumed that at least as good a response would be obtained from the inoculation of 1 ml. vaccine intracaudally as from 5 ml. subcutaneously. In view of the familiarity of the caudal fold route to field assistants the inoculation of 1 ml. vaccine by this route was studied.

Materials and Methods

The cultures of *Br. abortus,* Strain 19, used were obtained originally from the Ministry of Agriculture's Veterinary Laboratory, Weybridge, and were maintained in Vom as desiccates. All seed cultures were examined for dissociation and only those showing a minimum of rough forms were used. Growth was washed off Roux flasks with 0.85 per cent saline buffered at *pH* 6.8 with a phosphate buffer. After pooling the growth washed off all flasks, the concentration of organisms was estimated with a nephelometer, the reading being checked later by dilution plate counts. The concentrated vaccine was adjusted to contain 200,000 x 10^6 organisms per ml. Plate counts almost invariably gave rather higher readings than the nephelometer estimations. 0.5 ml. amounts of vaccine concentrate were dispensed into ampoules containing 1.5 ml. of a

XUM

mixture of 75 per cent separated milk, 25 per cent buffered saline (*pH* 6.8) and 7 gm. per 100 ml. of added lactose. Early trials had shown that the addition of lactose gave higher viability readings after desiccation than the plain separated milk medium. Several batches of vaccine were also prepared using 75 per cent bovine serum broth with 7 gm. per 100 ml. of added lactose, the "Mist. desiccans" of Fry and Greaves.

To prevent contamination the necks of the ampoules were covered with single layer lint sterility caps. The ampoules were then processed in the primary system of an Edwards' Model 3PS centrifugal freeze dryer for 8-10 hours. The necks of the ampoules were then drawn out to facilitate sealing and the material was processed on the secondary system for a further 12 or more hours. After sealing under vacuum, the vacuum in each ampoule was tested with a high frequency tester prior to storage in an ordinary domestic refrigerator. In the early stages of the work it was the practice to push sterile cotton wool plugs down the necks of the ampoules before secondary drying. The necks of the ampoules were drawn out above the plugs. Whilst the plugs prevented contamination by airborne organisms, they were found to interfere markedly with the rate of desiccation and, frequently, when ampoules were opened by field assistants, the plugs were carried down by the inrush of air.

The material in each ampoule was designed to contain 4 ml. of vaccine on reconstitution with distilled water. Approximately, 100,000 x 10^6 organisms, usually more, were added to each ampoule when the 0.5 ml. of concentrate was mixed with the milk suspending medium. Allowing for a loss of 50 per cent of viable organisms during desiccation, each 1 ml. of reconstituted vaccine contained 12,500 x 10^6 viable organisms per ml. This figure lies between the B.A.I. standard of 10,000 x 10^6 per ml. and the Ministry of Agriculture's 16,000 x 10^6 per ml. Fluid vaccine was prepared in the same manner as the concentrate for the desiccated vaccine but was adjusted to contain approximately 15,000 x 10^6 organisms per ml. Viability counts on concentrated and prepared vaccine were carried out by plate counts on potato dextrose agar. Dilutions were carried to 10^{-7} and plates were read after 48 hours incubation.

The serological reactions of cattle following vaccination were assessed by the agglutination test carried out according to the method of Stableforth (1936) using antigen prepared from Weybridge agglutinating Strain 99. Results were read as the tube showing 50 per cent (++) agglutination.

Results

It was necessary to ascertain the loss of viable organisms caused by freeze drying in a slightly different medium and using different drying equipment and methods as compared with those of Verwey (loc cit.). Figures obtained by dilution plate counts are given for five batches of vaccine in Table 1. Counts were also carried out on the same batches of vaccine after periods of storage of three and six months under ordinary refrigerator conditions (4° C.). Figures are also given for vaccine desiccated in "Mist. desiccans." The use of this medium was discontinued when it was found that the desiccated product took

considerably longer to reconstitute than the milk medium product which went into suspension rapidly.

TABLE 1

Loss of Viability of Strain 19 Vaccine during Desiccation and on Storage at 4° C.

No. of organism per ml. in undesiccated material	% survival after desiccation in milk medium	% survival after 3 months at 4° C.	% survival after 6 months at 4° C.	% survival after desiccation in "Mist desiccans"
53 x 10^9	57	54	53	55
51 x 10^9	53	51·5	52	51
57·5 x 10^9	63·5	61	59·5	—
54 x 10^9	52·5	51	49	49
53·5 x 10^9	56	54	51·5	—

The results show that, in practice, the survival rate immediately after desiccation has been higher than the 50 per cent assumed originally. Survival figures following storage for three and six months at 4° C. show no significant differences and indicate that the vaccine may be stored safely for a considerable period. It may be assumed from Verwey that under these conditions the vaccine survives for considerably longer than six months. This period is sufficient for practical purposes in Nigeria.

Vaccination of Cattle

Thirty White Fulani (Zebu) heifers of 9-12 months old, of known history and which had not previously been vaccinated, were available. They were divided into four groups and were vaccinated as follows:—

Group 1. Seven animals given 5 ml. fresh fluid vaccine subcutaneously behind the right shoulder. The area of inoculation was massaged to disperse the vaccine.

Group 2. Eight animals given 5 ml. reconstituted desiccated vaccine subcutaneously as in Group 1.

Group 3. Seven animals given 1 ml. reconstituted vaccine intracaudally about 1 in. from the tail tip.

Group 4. Eight animals given 1 ml. reconstituted vaccine into the caudal fold.

Reactions to Vaccination: In Groups 1 and 2 there was no detectable difference in either the local or the systemic reactions. The usual large swellings had developed after five days. They were painful on palpation and approached a diameter of 8 in. in some cases. Animals in both groups showed rises of temperature between 24 and 48 hours after vaccination. Temperatures in some cases reached 104° F. These lasted for up to 48 hours before subsiding. In the second week after vaccination the local swellings began to subside leaving small areas of induration palpable for a month or more. In one case this area could be detected after three months.

XUM

In Group 3 cylindrical swellings around the tail developed within a week of vaccination and extended over a length of about 2 in. They appeared to be rather painful when handled gently. These swellings were difficult to detect after three weeks. Four animals in this group showed transient temperature rises.

In Group 4 firm round swellings developed within a week of inoculation. They were surrounded by a varying degree of œdema. At their maximum none of the swellings was more than 3.5 cm. in diameter. They were painful and hot to the touch. The œdematous area was most marked in the loose soft skin under the tail, occasionally extending down to the rim of the anus. In no case was the œdema sufficient to cause any trouble. The swellings and the œdema subsided within two to three weeks but small areas of induration could be detected for two or more months. Raised temperatures, similar to those recorded in other groups, were shown by all eight animals during the first three days after vaccination.

Agglutination Reactions: The rise in agglutinin titres in response to vaccination is shown in Table 2. The results are expressed as a tube number of doubling dilutions of serum from 1 in 10 upwards. Response to vaccination did not appear to differ markedly in any of the four groups although it seemed that Group 3 responded more than the others.

The reactions recorded show little difference from those reported by other workers. Maximum titres were reached at the end of the second week after vaccination in the majority of cases. Titres then fell gradually but some animals exhibited low titres a year after vaccination. It was not possible to continue testing beyond this period. There was no difference between the subcutaneous inoculation of fluid vaccine and desiccated vaccine.

As a desiccated, Strain 19 vaccine requires twice as much vaccine suspension to produce a single dose when compared with a fluid vaccine, considerations of economy necessitated that the subcutaneous route be avoided. The intracaudal and caudal fold routes both appeared to be suitable. The former route was preferable as it had been studied more closely elsewhere by Campbell and Rodwell and McDiarmid but difficulty was encountered in administering the full dose of 1 ml., considerable pressure having to be exerted on the piston of the syringe on occasions, while the animals evinced signs of pain during the inoculation. It was considered that the results of vaccination via the caudal fold, were sufficiently encouraging for this route to be tested under field conditions.

Trials were carried out on Government farms in different parts of Nigeria using White Fulani (Zebu) cattle, "muturu" or West Africa shorthorns and N'Dama cattle. Considerable difficulty was experienced in getting sera from the various farms to the laboratory owing to delays in transport and only a pre-vaccination and one post-vaccination test were possible.

Local and systemic reactions obtained in the various herds were very similar to each other and to those obtained in Group 4. The vaccine used had been prepared three months before it was issued. In most cases the vaccine was sent

TABLE 2

Agglutinin Response in White Fulani (Zebu) Heifers to Vaccination with a Desiccated Strain 19 Vaccine by Different Routes.

Group	Heifer No.	Titre 1 week before vaccination	Titres after vaccination (weeks) 1	2	3	4	24	52
1.	2745	—	5	8	5	4	1	—
Subcutaneous	2754	—	13	9	6	5	2	—
(Fluid Vaccine)	2774	—	8	10	7	6	3	2
	2763	—	9	8	6	4	2	1
	2768	—	9	9	6	5	2	2
	2743	Tr.1	5	8	6	4	1	1
	2713	—	5	4	5	5	1	—
2.	2764	—	6	6	3	1	—	—
Subcutaneous	2756	Tr.1	12	11	7	7	2	1
(Desiccated Vaccine)	2739	—	5	8	6	6	Disposed of	
	2737	—	6	8	6	5	2	1
	2698	—	6	8	7	5	2	2
	2741	Tr.1	7	9	7	9	3	1
	2732	—	6	5	5	5	1	—
	2752	—	7	6	4	4	2	—
3.	2728	—	8	9	8	6	2	2
Intracaudal	2746	—	7	10	9	6	3	2
	2688	Tr.1	9	9	8	7	4	1
	2766	—	2	9	7	6	2	1
	2717	—	10	10	7	6	3	1
	2721	1	7	7	5	4	2	—
	2772	—	9	11	7	7	3	2
4.	2793	—	7	10	6	8	4	2
Caudal fold	2782	—	7	9	8	5	4	1
	2637	—	9	7	7	6	3	2
	2666	1	6	7	8	5	1	—
	2692	—	6	6	7	4	1	1
	2779	—	8	5	4	4	2	1
	2642	—	7	9	8	5	3	1
	2782	—	7	8	5	6	2	—

by air in thermos jars but in one case it was necessary to despatch it over 500 miles by road in hot weather and with no possibility of replacing the ice in the jar.

In all, more than 200 cattle were vaccinated at the various farms. Agglutinin titres resulting from vaccination ranged from 1 in 80 to 1 in 10,240 at all the farms, most animals showing titres of 1 in 320 or 1 in 640, 14 to 20 days after

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vaccination. There appeared to be no breed difference in the reactions of the animals. No local or systemic complications were reported in any of the animals.

Results following the routine use of the desiccated Strain 19 vaccine on Government farms, from where it has been possible to obtain pre-vaccination and post-vaccination serum samples, have been of the same order as in the laboratory and field trials. The keeping qualities of the vaccine have shown that it is able to withstand the difficult conditions of transport to which it may be submitted.

Discussion

The desiccated Strain 19 vaccine described is fundamentally the same as that described by Verwey and Scheidy apart from the addition of lactose to the suspending medium and desiccation on a different apparatus. It is necessary to assume a loss of viability of 50 per cent during desiccation of the vaccine and this entails the production of twice as much vaccine concentrate as would be required for a fluid vaccine. Whilst the desiccated vaccine has solved the problem of agitation which affects seriously a fluid vaccine, it must still be protected against temperature variations. This is considerably more easy than with a fluid vaccine. Desiccated vaccine is more laborious and more expensive to produce but the extra work is justified by the keeping qualities once it is made.

Agglutination titres, following the vaccination of cattle, have been satisfactory. In the laboratory trial the usual gradual fall off was noted with a persistence of a titre for over 12 months in some animals.

The caudal fold inoculation is, in fact, a subcutaneous injection and there is, at present, no explanation why the agglutinin response to a smaller dose of vaccine by this route is of the same order as the response to the normal 5 ml. subcutaneous inoculation behind the shoulder. The intracaudal route was found to be difficult and pain was caused during the injection, necessitating a greater amount of restraint. The caudal fold route is used as a routine in Nigeria and, where it has been possible to get serum samples, the results have been uniformly good and of the same nature as in the laboratory and field trials.

Summary

The methods of production of a *Br. abortus,* Strain 19, vaccine are described. The vaccine is desiccated in a skim milk and phosphate buffer medium with added lactose.

The loss of viability during desiccation has been less than 50 per cent. On storage, little further loss of viability has been recorded after six months.

Reconstituted vaccine at a dose of 1 ml. is administered via the caudal fold. This route appears to give as good results as the normal subcutaneous and the intracaudal routes.

Acknowledgments

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THE REACTION OF THE WHITE BLOOD CELLS AT PARTURITION IN THE SOW

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KERR, ROBERTSON AND MCGIRR (1951) reported on the changes to be observed in the numerical relationships of the white blood cells of the cow at parturition. A drop in the number of lymphocytes and a rise in the neutrophils was found. This reaction was apparent in some cows prior to calving, and in others it took place after calving. These authors drew attention to the similarity between the type of blood reaction at parturition and that due to the action of adrenal cortical steroids. Observations have been made on the white cell changes at farrowing in a group of seven sows. In all a lymphopenia took place at or about the time of farrowing. There was some variation within the group in the behaviour of the cells, and typical examples are described in detail below.

Normally in the pig the number of neutrophils is always lower than that of the lymphocytes. For example, in a series of 110 blood samples taken from normal pigs of various ages, the average differential count was: total white cell count, 19,866; neutrophils, 6,363 (32 per cent); lymphocytes, 13,076 (66.4 per cent); and eosinophils, 327 (1.7 per cent).

Sow C had been under observation for 30 days prior to farrowing. Three differential blood counts during the first 14 days showed lymphocytes and neutrophils almost equal in number, though the neutrophils were always slightly fewer than the total lymphocytes. Between 16 and 9 days before farrowing the lymphopenia was established. This was at its peak just prior to farrowing, when the neutrophil : lymphocyte ratio was 77 : 22.5. The total white cells tended to decrease during the 6 days prior to farrowing and conversely the

neutrophils showed a marked increase during this period. After farrowing there was a sharp increase in the number of lymphocytes and a decrease in neutrophils, though the pre-parturition lymphocyte : neutrophil relationship was not established until 8 days *post partum*.

Sow No. 56.—During the week prior to farrowing the total white cells showed a drop. This fall in the total white cells was reflected fairly equally in both lymphocytes and neutrophils up to about 30 hours before parturition commenced. At this period there was a further drop in the number of lymphocytes and a rise in the neutrophils, producing the characteristic cross-over reaction. Six hours before farrowing the neutrophil : lymphocyte ratio was 58 : 42. Normal cell ratios were re-established within 48 hours after parturition, and during the next 4 days the total number of lymphocytes and neutrophils increased to normal levels once again. (See Fig. 1.)

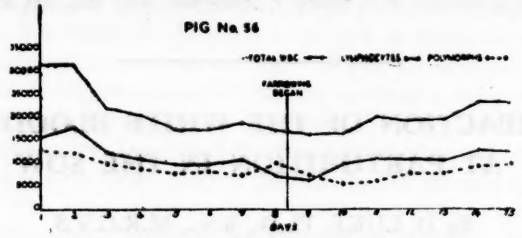

FIG. 1
White cell counts during the farrowing period.

Sow No. 58.—This pig showed a fairly similar blood picture as that described for Sow 56. The decline in total white cells was apparent at least 3 days prior to farrowing. The lymphopenia was apparent at least 7 hours before parturition. At farrowing the neutrophil : lymphocyte ratio was 72.5 : 27.5. Normal white cell ratios were re-established within 48 hours after farrowing. (See Fig. 2.)

Sow No. 60.—The cell values here showed the same general trend before parturition. A lymphopenia was established, but only a slight neutrophilia. The cross-over reaction was not marked in this case and lasted only a very short

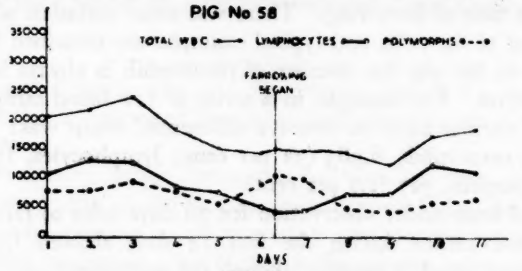

FIG. 2
White cell counts during the farrowing period.

time. At the blood examination a few hours prior to farrowing the cross-over had not taken place. A neutrophil : lymphocyte ratio of 56 : 43 was recorded about 6 hours after farrowing.

In the other three pigs in this group the cross-over reaction was apparent between 6 and 10 hours before farrowing and lasted 24 to 96 hours after parturition. It was not found possible to carry out complete counts in these three pigs. However, the widest neutrophil : lymphocyte ratio in these pigs was also recorded at or just after farrowing.

Of the seven sows under consideration, six commenced parturition with the lymphocytes and neutrophils in the reverse position. In five of these the change-over took place between 6 and 30 hours prior to the commencement of parturition. Sow C was exceptional in that the lymphopenia was apparent at least 9 days before parturition commenced. In one case the drop in the number of lymphocytes was seen only after parturition. Kerr *et alia* (1951) presented seven detailed records for the white cell counts of the cow before, during the after parturition. Of this group, four showed the lymphopenia after calving and in three the lymphocyte changes were observed before calving.

The changes in the blood at farrowing in the sow are comparable with the results following the injection of ACTH or cortisone. In both there is the depression in the number of lymphocytes and an increase in the number of polymorphs, and following parturition there is a marked increase too in the total number of white blood cells. Though the actual sequence of hormonal activities which terminate pregnancy and initiate parturition are not known in detail, the evidence from the blood responses recorded above suggests that the pituitary-adrenal-cortex hormone complex is involved.

Essentially similar changes are seen in the relationship of the white blood cells in a variety of reactions. Apart from parturition, the lymphopenia and neutrophilia are produced under the influence of adrenal cortical extracts and with adreno-corticotrophic hormone (White and Dougherty, 1946; Hills *et alia*, 1948); during the reaction resulting from the intradermal injection of tuberculin in the sensitised animal (Kerr *et alia*, 1946; Luke, 1951); and under the influence of restraint or subcutaneous faradic shock (Colfer, de Groot and Harris, 1950).

There seems little doubt but that the reaction under discussion occurring regularly under the influence of a variety of conditions must have an important biological significance. In this connection mention may be made of the work of Seyle (1950). This author has commented extensively on the variety of stimuli which result in a neutrophilia and a lymphopenia, and he has incorporated these changes into his concept of a "general adaptation syndrome" to include those changes which he regards as the non-specific reaction of the body to a wide variety of stimuli or "stressors." Seyle includes among these stressors such things as adrenalin, exposure to cold, trauma, forced muscular exercise, emotional stress, acute infections, gout, etc. The fact that such a wide variety of stressors can induce essentially the same blood response is taken as indicating the non-specific nature of the changes thus brought about. The evidence suggests that the mechanism bringing about the typical blood reaction involves the secretion of the adrenal cortex and that the pituitary-adrenal-cortex complex may be activated in a variety of responses following widely different stimuli.

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Summary

At parturition in the sow there is a well-marked lymphopenia and a neutrophilia. The blood reaction is usually apparent 6 to 30 hours prior to parturition. Exceptionally it may be evident as much as 9 days before farrowing, or may be delayed until after farrowing has commenced.

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FIBROPAPILLOMATOSIS IN CATTLE WITH SPECIAL REFERENCE TO THE EXTERNAL GENITALIA OF THE BULL

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Introduction

So-called warts of the skin in young female cattle are commonplace and unless they are present in profusion they seldom attract attention or warrant removal. Histologically they are fibropapillomata and it is generally accepted that they are of virus origin and are transmissible (Boley, 1940). Usually by the time the heifer reaches the age of 2 to 2½ years these warts have regressed or disappeared.

The writer has not seen fibropapillomata involving the female genital tract of cattle, but Williams in America mentions 15 of a group of 26 maiden heifers which exhibited epithelial tumours of the vulva. McEntee (1950) from a study of 55 cases of fibropapillomata of the bovine genital tract found that 28 involved the vulva and vagina and 27 the penis. Franklin (1946) described a neoplasm of the vaginal wall in a shorthorn heifer which was removed surgically when the heifer was one year old, but had recurred at the time the animal was due to calve. Regression followed a stilbœstrol implant enabling a circumscribed growth the size of an orange to be removed surgically five months later, this time without recurrence—at any rate, up to fifteen months after calving. The tumour was diagnosed histologically as a fibrosarcoma but McEntee in quoting Franklin's case suggests that in view of the close histological similarity between fibropapillomata and fibrosarcomata this was a mistaken diagnosis.

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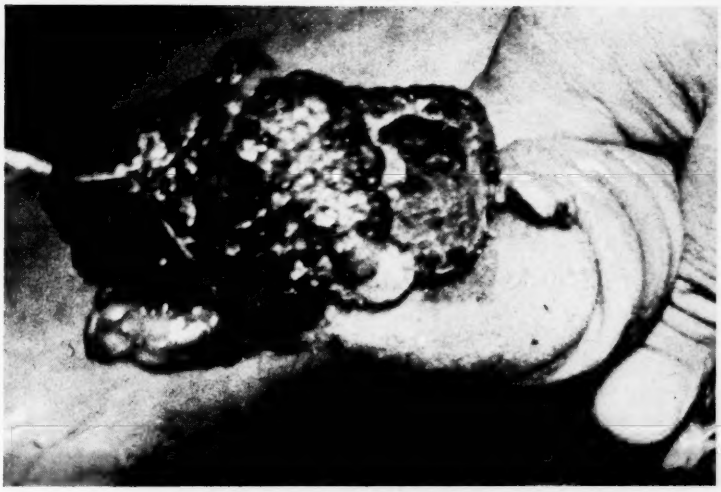

FIG. 1
Fibropapillomata of the Glans Penis of a 10-month-old Shorthorn bull at the time of their removal.

FIG. 2
The Glans Penis of the same subject at 15 months of age when slaughtered.

(*Article by Formston, page 244*)

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In view of the alleged transmissibility of these benign neoplasms and the relative frequency with which they are found in young bulls in this country, one would expect to find, if only occasionally, similar growths in the vaginal tracts of heifers. It is not unreasonable to postulate that at the time of service heifers have reached an age at which they possess some degree of natural immunity.

A survey of English veterinary literature reveals a dearth or, one might say, an absence of clinical data on neoplasms of the external genitalia of the bull and for this reason this contribution is submitted.

Subject Matter

Twelve bulls with neoplasms of the penis have been examined by the writer and a thirteenth case was a post-mortem specimen. In all but one case the histological nature of the growth has been determined. Up to the present only four breeds have been involved: Ayrshire, 5; Friesian, 3; Shorthorn, 3; and Red Poll, 2. The tumours were removed surgically in nine bulls. In two cases, bulls of 2 years and 2½ years, there was a history of previous operation which, in the older animal, had consisted of removal of, approximately, half of the glans penis. In only three bulls was removal followed by recurrence. These were aged 10, 12 and 14 months respectively. In the two younger ones recurrence was rapid and the growths had reached their former size within three to four weeks. When there was no recurrence the subjects were 15 months of age or older.

Clinical Features

In the majority of bulls the lesion is not noticed until the animal is used for service. Quite often this is only when service has been completed and hæmorrhage has been observed from the penis, either when extruded or retracted into the sheath. Some bulls refuse to complete the service if the growth becomes injured and bleeds. When this happens the bull may be rested for a week or two, but by the end of this time the neoplasm may have grown appreciably. At other times the fibropapillomatous mass is of such size that it protrudes from the prepucial opening and prevents complete retraction of the glans penis. Under such circumstances superficial infection, ulceration and necrosis are constant features. In most instances these neoplasms are rarely more than three or four in number and are confined to the glans penis proper. The prepucial mucous membrane may harbour small ones, usually at its point of reflection from the glans. In two cases "warts" on the prepucial skin coincided with fibropapillomata of the glans penis. Those of the glans are cauliflower-like in appearance, particularly in the young bull when they have been seen of a size 9 cm. by 6.5 cm. by 5.5 cm. During this active stage they are more or less sessile and very vascular. In older bulls, 15 to 18 months, with occasional exceptions, the growth averages 4½ by 2½ by 2½ cm. and it is more fibrous and less irregular in appearance. Vascularity is reduced although the size of the veins at the time of removal often gives the impression of concernible

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hæmorrhage, and whilst they are seldom pedunculated the area of attachment to the penis becomes smaller. In bulls in the region of 2 years of age pedunculation may be quite pronounced, and removal is a simple matter and hæmorrhage slight. One two-year-old bull of this series exhibited small tag-like fibromata irregularly studded over the glans penis. They caused no interference with desire or use as a stock bull.

Surgical Procedure

In the recumbent bull it is not always an easy matter to extrude the penis even when it is thought that sufficient anæsthetic solution has been given epidurally to paralyse the retractor penis muscle. For this method to be successful fairly full dosage is required, at least to the extent that motor control of the hind legs is lost. For reasons which may not be stated here, the writer does not favour anterior epidural anæsthesia in cattle. Consequently, this form of anæsthesia and restraint has not been used. The best results have likewise not been achieved when using either chloral hydrate narcosis or chloroform singly or in combination. The technique of withdrawing and securing the penis, which is now adopted, is that used by Mr. T. Norman Gold, of Redditch, who very kindly demonstrated it to the writer in 1947. In describing the method here the indebtedness to him is gratefully acknowledged.

The bull is taken from its pen and is led up to a cow or heifer of convenient size and is allowed to mount. It is usually immaterial whether the cow is in œstrus or not. On no occasion has it been found that an affected bull would refuse to initiate the act of coitus. When the penis is extruded a snare of moistened 2 in. bandage is slipped over it and drawn reasonably tight at a point posterior to the glans and the growths. The free ends of the snare are then released and service is not allowed to be completed. With retraction of the penis part of the snare is withdrawn into the prepuce. It should be noted that the piece of bandage used should not be so long that the free ends trail on the ground otherwise the bull may step on them and indirectly injure its penis. Everything is now ready for the patient to be cast on its side and the legs secured. By gentle but firm traction on the snare the penis may be withdrawn from the prepuce. It can be secured and held in position by an assistant who grasps the organ with the aid of a damp cloth above the site of operation. Anæsthesia is effected by local infiltration using a dental syringe and needle. In a severe case the whole of the glans penis may be anæsthetised and when this has been effectively carried out it is found that the tendency on the part of the bull to retract the penis disappears. The fibropapillomata are removed with curved scissors. It has been found that in this way the tumours are removed cleanly with minimal damage to the penis itself. As a rule hæmorrhage is not severe but in some cases the temporary application of adrenalin swabs may be necessary. The snare is removed, an antiseptic emollient is applied to the glans penis and the penis is allowed to recede into its sheath. Immediately the operation is completed the bull is permitted to regain its feet. It has been observed that when the whole of the glans penis has been anæsthetised the bull allows the glans to protrude and hang from the prepuce for some little while

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following the operation. He may or may not withdraw it when stimulus is applied to the organ. This protrusion is of no consequence and when the effect of the anæsthetic has passed off the penis is retracted voluntarily. No post-operative treatment is required but the bull should be rested for two or three weeks before being used for service. He may be "teased" at an earlier date to ascertain the nature of healing or for possible recurrence of the lesion.

Discussion

Young bulls under the age of two years are generally required for a specific purpose, as part of a breeding schedule or for the purpose of covering the young heifers. If the bull is incapacitated for only a short while plans are upset, and there is a serious loss of breeding time. This is complicated in the average case by the uncertainty of opinion as to the length of time which must elapse before the bull is in a fit state to be used. It is essential, therefore, that the veterinary surgeon should be in a position to advise the owner as to the likely outcome of operative interference or the length of time the bull may be out of commission. Experience has shown that the younger the bull the more active the growth. Histologically there are very marked differences between the young and the old tumour. As shown by McEntee and constantly demonstrated by my colleague, P. L. Ingram, the tumour in the young bull is more cellular, exhibits little collagen but mitoses are fairly numerous. With age more collagen is seen, mitoses are uncommon and fibroblasts are much larger than usual. These histological changes fit in with the clinical picture. The value of biopsy is obvious particularly in the bull 14 to 16 months old. Another point which has emerged from this series of cases is that repeated injury such as might occur with frequent trial at service tends to maintain cell activity and the production of granulation tissue, whereas rest brings about more rapid quiescence and regression. The inference to be drawn is that surgical interference is not the complete answer in the young bull when the growth is exhibiting this cellular activity. Recurrence is almost certain to be the sequel. The nearer the bull is to two years of age the better the prognosis. Many owners are not prepared to wait this time during which the bull is acquiring an immunity and send the beast for slaughter.

It would appear that there is scope for the application of other measures either protective or curative which may be of greater benefit to the young bull than radical surgery. Recently Sumner (1951) has reported on the good results obtained by the use of "Anthiomaline" (Lithium Antimony Thiomalate) in a yearling heifer with multiple papillomata of the head. This view has received support from Crawshaw (1952) who treated three heifers (exact age not given) with this preparation. Since 1945 a chick embryo wart vaccine has been made available by the Jensen-Salsbery Laboratories in America for the treatment of warts in horses, cattle and dogs with apparently very satisfactory clinical trials. A vaccine may be found to be the best therapeutic or protective measure used alone or in combination with surgical interference.

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Summary

Tumours of the glans penis have been obtained from 13 bulls. Surgical removal was instituted in 12 cases and in three bulls under 15 months of age there was fairly rapid recurrence of the growth. Histologically they were all fibropapillomata. A technique for their surgical removal is described.

Acknowledgments

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SPONTANEOUS SARCOMAS OF BONE IN DOGS: 30 CASES

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SPONTANEOUS TUMOURS OF BONES in dogs are not rare. For example, in a series of 1,211 tumours from dogs that were examined at the Royal Veterinary College in the decade beginning in January, 1940 (Cotchin, 1951), 41 (3.4 per cent) were primary tumours of bone; all but one of these were sarcomas. In that series, 19 of the 37 dogs of which the age was known were 8 or more years old; tumours of the ribs were seen in animals 1½ and 2 years old respectively, and a sarcoma of the tibia was seen in a 2-year-old dog. The larger breeds of dog figured prominently in the list of those affected, and 28 of the 40 sarcomas were from the bones of the limbs.

In the three-year period since this series of 40 sarcomas was seen, 820 further neoplasms from dogs have been examined and of these 30 (3.7 per cent) were tumours of bone. The findings in this present series are roughly in accord with those in the previous one and allow some points of interest to be amplified. Details of the cases are summarised in Table 1, which shows the age, breed and sex of the affected animal, the site of the tumour, the type of tumour present, the duration of the clinical history before post-mortem examination, and the presence of metastases.

Age Incidence

The age of the affected animals varied from 1½ to 13 years, the average being 7 years. A noteworthy feature was the early age at which tumours

TABLE I

Details of 30 Cases of Spontaneous Sarcomas of Bones of Dogs

Case No.	Age (yrs.)	Breed	Sex	Bone affected	Site of tumour	Type of tumour	Duration of clinical history before p.m.e.	Presence of metastases
1	4	St. Bernard	m.	Humerus	Left, upper end	Osteosarcoma	4–6 weeks	+
2	6	Irish Wolfhound	m.	Humerus	Left, upper end	Osteosarcoma	2 months	+
3	6	Bull Terrier	f.	Humerus	Left, upper end	Osteochondro-sarcoma	3 months	0 *
4	7	Great Dane	m.	Humerus	Right, upper end	Osteosarcoma	3 weeks	0
5	8	Greyhound	f.	Humerus	Right, upper end	Osteosarcoma	6–8 weeks	+
6	9	Dalmatian	f.	Humerus	Left, upper end	Osteosarcoma	6 months	+ ?
7	9	Great Dane	m.	Humerus	Left, upper end	Osteosarcoma	4 weeks	+ ?
8	13	Collie	m.	Humerus	Left, upper end	Osteochondro-sarcoma	2 weeks	+
9	Not known	Great Dane	f.	Humerus	Right, upper end	Osteosarcoma	Not known	0
10	1½	Retriever	m.	Rib	6th right, lower end	Osteosarcoma	5 weeks	0
11	1½	Alsatian	m.	Rib	3rd right, lower end	Osteosarcoma	6 weeks	+
12	2	Borzoi	m.	Rib	6th left, lower end	Osteosarcoma	2 months	+ *
13	2–3	Retriever	f.	Rib	10th and 11th left	Osteochondro-sarcoma	3 months	0 *
14	10½	Mongrel	f.	Rib	Left	Chondrosarcoma	Since youth	+
15	5	Great Dane	f.	Femur	Left, lower end	Osteosarcoma	2 months	+
16	5½	Mongrel	m.	Femur	Left, lower end	Osteosarcoma	A few weeks	0
17	6	Retriever	m.	Femur	Right, lower end	Osteosarcoma	Not known	+ *
18	7	Borzoi	m.	Femur	Right, lower end	Osteosarcoma	"Year"	+ *
19	9	Retriever	m.	Femur	Left, lower end	Chondrosarcoma	3 months	0
20	3½	St. Bernard	f.	Radius	Right, lower end	Osteosarcoma	2 weeks	0
21	5	Alsatian	f.	Radius	Right, lower end	Osteosarcoma	5 months	0
22	6	Great Dane	m.	Radius	Both, lower end	Osteosarcoma	6 weeks	0
23	12	Alsatian	m.	Radius	Right, lower end	Osteosarcoma	4 weeks	0
24	3–4	Greyhound	m.	Tibia	Left, lower end	Osteosarcoma	6 weeks	0
25	8	Great Dane	f.	Tibia	Left, lower end	Osteosarcoma	3 weeks	0
26	10	Mongrel	m.	Tibia	Right, lower end	Sarcoma	(Biopsy)	*
27	7–8	Retriever	m.	Scapula		Osteosarcoma	Not known	+ *
28	10	Mongrel	m.	Ulna	Right	Osteosarcoma	6 months	0 *
29	9	Spaniel-cross	m.	Phalanx	5th left, proximal	Osteosarcoma	2–3 months	+
30	10	Alsatian	f.	Ethmoid	Right	Chondrosarcoma	3–4 months	0 *

* Full post-mortem examination was not made personally.
? Small lesions which appeared to be metastases were present in the lungs, but they were not found in prepared sections.

appeared in the ribs, as with one exception the animals were under 3 years of age. This tendency for some tumours of bone to develop in the young is also seen in man: for example, nearly two-thirds of one series of patients mentioned by Willis (1948, p. 677) were between the ages of 10 and 30, a span of life which probably corresponds to something like ½ to 4 or 5 years of age in the dog.

Breed Incidence

Large dogs are more prone to develop bone tumours than are small dogs. None of the animals in the present series was small, and most were large (Great Dane, 6; Retriever, 5; Alsatian, 4; mongrel, 4; Greyhound, 2; Borzoi, 2; St. Bernard, 2; Bull Terrier, Collie, Dalmatian, Irish Wolfhound, Spaniel-cross, 1 each). The reason for this incidence in larger dogs is not known; hereditary factors may be involved but no definite information on this point is available. On the other hand, it has been suggested that the cause of bone sarcomas is to be looked for chiefly in disturbances of bone growth and of maturation (Willis, 1948, p. 678), and it might be significant that the large breeds of dogs seem more often to develop rickets and osteoporosis than do the small breeds. It is not known whether any of the bone tumours in this series arose in pre-existing osteodystrophic lesions.

Sex Incidence

Nineteen of the 30 tumours occurred in males, and 11 in females. This agrees with the usual experience that, apart from mammary neoplasms, tumours

TABLE 2

Some Sarcomas or probable Sarcomas of Limb Bones in the Dog recorded since 1930

Bone	Animal affected	Site	Author
Humerus	7 y.o. Matinee f.	Upper part	Quarante (1931)
	8 y.o. Groenendaler	Upper part	Klarenbeek (1937)
	9 y.o. Boxer	Upper part	Klarenbeek (1937)
	9 y.o. Collie m.	Upper part	Schnelle (1937)
	— Cross-bred	Upper part	Smythe (1933)
	— Newfoundland	Upper part	Klarenbeek (1937)
Radius	3½ y.o. St. Bernard m.	Lower part	Bloom (1936)
	3½ y.o. Bulldog m.	Lower part	Bloom (1936)
	4 y.o. Great Dane	Lower part	Schnelle (1937)
	8 y.o. Collie m.	Lower part	Bouchet and Bouchet (1935)
	8 y.o. Irish Wolfhound m.	Lower part	Anderson (1933)
	9 y.o. Collie spayed f.	Lower part	McClelland (1941)
	11 y.o. Mongrel	Lower part	Schnelle (1937)
Ulna	4 y.o. English Setter f.	Almost complete destruction	Schnelle (1937)
	8 y.o. Newfoundland m.	Almost complete destruction	Claassen (1936)
	8 y.o. Trekhond		Klarenbeek (1937)
Femur	5 y.o. Springer Spaniel	Lower part	McClelland (1941)
	7 y.o. Collie f.	Lower part	Hewetson (1933)
Tibia	2 y.o. Irish Wolfhound	Lower part	Male (1936)
	5 y.o. Borzoi	Lower part	Klarenbeek (1937)
	5 y.o. Golden Retriever	Lower part	Kirk (1938)
	6 y.o. St. Bernard	Lower part	Klarenbeek (1937)
	"Old" —	Lower part	Quarante (1932)
	— —	Lower part	Ajello (1935)

are more often found in male dogs than in females; it also parallels the observation that sarcomas of bone in humans are seen more frequently in males.

Site Incidence

It is generally agreed that most sarcomas of bone in the dog occur in the long bones of the limbs (Coquot and Moussu, 1927), although other bones may occasionally be affected. Some recorded tumours of limb bones from dogs are summarised in Table 2, which is based on a limited review of the literature since 1930.

It is seen that tumours occur in the upper part of the humerus and in the lower part of the radius, femur and tibia. With the exception of the tibia, these sites correspond with that part of the bone in which the longer epiphyseal line is situated.

Apart from the tumours of limb bones listed in Table 2, other sites of recorded sarcomas of bones in dogs include the occiput and the maxilla (Bossert, 1939), the bone above the roots of the upper posterior molars (Fages, 1934), the upper jaw (Freese, 1926), the ethmoid and frontal regions (Schlotthauer, 1934), the sphenoid bone (Taube, 1923), the ischium (Claassen, 1936), the os pubis (Joest, 1921), the left side of the chest (Schlotthauer, 1942) (although it was thought that this tumour may have arisen from either a rib or a bronchus), and the ribs (Quarante, 1931). A primary adamantinocarcinoma of the lower part of the left humerus has been described (Nielsen and Schnelle, 1952). In his thesis, Bossert (1939) refers, apart from his own cases, to sarcomas of the "shoulder," lumbar vertebræ, femur, cranium, ribs, carpus, digit, humerus, and scapula.

Classification

In 21 of the 30 cases recorded here, a full post-mortem examination of the dog was made by the writer. Each tumour was examined histologically and they were, in general, cellular sarcomas with variable and sometimes considerable production of an intercellular matrix. This could at times be readily identified as being bony or cartilaginous, but it was often indeterminate in nature, sometimes recalling the "atypical" bone described by Weinmann and Sicher (1947). In many of these cases a considerable quantity of non-neoplastic bone was produced by the periosteum, and sometimes in the marrow cavity. In some, this bone appeared to be produced in greater amounts than the neoplastic bone. The periosteal bone proliferation extended some way from the site of tumour formation, and in some it gave the appearance of being a support compensating to some extent for the destruction of bone by the tumour. The amount of bone formed by the periosteum was more than is generally seen with bone sarcomas in man—this might be related to the fact that the affected dog may take weight on the affected limb more readily and for a longer period than does the human patient.

Some objection may be taken to the term "osteogenic sarcoma," which is now well entrenched in human pathological terminology, on the ground that, although it might be thought to mean "bone-forming sarcoma," it is in fact

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meant merely to indicate a sarcoma originating in bone. The term "osteosarcoma" or "chondrosarcoma" may be preferred where the matrix formed is of a bony or cartilaginous nature, the term "sarcoma" being used if there is some uncertainty of the exact direction of differentiation of the neoplastic cells. Assuming that the atypical material present in some of the tumours is of a bony nature, then in this series of 30 tumours there were 26 osteosarcomas (of which 3 also showed cartilage production and could thus be called osteochondrosarcomas), 3 chondrosarcomas, and 1 sarcoma.

Clinical Features

An obvious swelling at the site of the tumour might be noticed first, but in some dogs the attention of the owner was drawn to the limb by the onset, often sudden, of lameness, which sometimes followed a trivial injury or had no obvious cause. A sprain or strain was often suspected, and professional advice was only sought when the lameness had not resolved quickly, or had recurred after temporary disappearance. The lesions may have been present for some little time before lameness developed. As soon as the diagnosis of bone sarcoma was made, it was generally recommended that the animal be destroyed, and the full clinical course of the disease was not run. Even so, in 12 of the 30 cases, metastasis had already occurred at the time of destruction, and this is shown in Table 3. Metastases were detected in the lungs in all but 1 of the 12 cases.

TABLE 3

Production of Metastases by Sarcomas of the Bones of Dogs in a Series of 30 Cases

Bone affected	No. of tumours	No. of cases with metastases	Site of metastases
Humerus	9	4 (? 6)	Lung (4, ? 6) Local node (1)
Rib	5	3	Lung (3) Local node (1)
Femur	5	3	Lung (2) Local node (1)
Radius	4	0	
Tibia	3	0 *	
Miscellaneous	4	2	Lung (2)
	30	12 (? 14)	Lung (11, ? 13) Local node (3)

? Small nodules which appeared to be metastases were present in the lungs, but were not found in prepared sections.
* Biopsy specimen only from 1 case.

This tendency for metastasis to be present early in the clinical course of the disease suggests that any treatment directed at the local neoplasm, whether surgical or radiological, is likely to be of limited value. For example,

Glücksmann (1952) mentions a case of sarcoma of the tibia of a dog, in which the primary tumour was sterilised by local irradiation, but actively-growing metastases were present in the lungs. It would seem to be impossible to make certain that metastases were not present in the lungs or elsewhere by clinical examination. The lung lesions may be microscopic; on the other hand, enlargement of the regional lymph node is often noted and this does not necessarily indicate anything more than hyperplasia, often with erythrophagia and hæmosiderosis. In only three cases was metastasis detected in the local lymph node, in two cases along with pulmonary metastases.

An account of the main pathological features of the neoplasms in the different bones follows.

Humerus

Of the nine tumours of the humerus one (case 8), from a 13-year-old Collie dog, was an osteochondrosarcoma ensheathing the middle and upper thirds of the almost uninvolved shaft of the humerus. The matrix of this tumour suggested cartilage in parts, but in other parts the appearances were of an atypical osteoid material. One metastatic lesion alone was found, growing in a blood vessel in the lung (Fig. 3) Another tumour (case 5), from an 8-year-old Greyhound bitch, was a very vascular osteosarcoma, and lay mainly outside the bone in the upper third of the shaft, with minimal bone destruction; numerous metastases, in which a fair amount of pink-staining matrix was present, were found in the lungs. The other seven tumours gave the appearance of having grown mainly at first in the cortex and marrow cavity, later breaking out through the compact bone to spread more or less extensively in the surrounding tissues (Figs. 1 and 2). A variable and sometimes considerable production of non-neoplastic periosteal bone (and in one case [3] of cartilage also) occurred, which was most marked on the posterior border of the shaft. Pathological fracture, with considerable local hæmorrhage, occurred in two cases (case 1, in a 4-year-old St. Bernard dog, and case 2, in a 6-year-old Irish Wolfhound dog, Fig. 4). These seven tumours were all osteosarcomas (or in one case [3] an osteochondrosarcoma, Fig. 5), the cells being spindle-shaped, or more stellate, or more closely resembling osteoblasts, and producing a variable amount of intercellular matrix, which was in parts calcified (Fig. 6). Occasional osteoclasts were also present. There seemed to be no relation between the amount of matrix produced and metastasis.

Ribs

Five cases of rib tumour were seen. The lesions when small could be seen to arise from the region of the lower end of the bony part of the rib (Figs. 7 and 8). The tumours generally showed the greatest growth in a medial direction, which might lead to considerable dyspnœa, but one from a 1¾-year-old Alsatian dog (case 11) showed extensive swelling laterally, partly accounted for by massive local hæmorrhage. Four of the five animals were young. The exceptional animal was a 10½-year-old mongrel bitch (case 14), which was thought to have fractured a rib when young and had shown a slowly progressive

dyspnœa over a long period before it was destroyed. At post-mortem examination a cartilaginous tumour, measuring 15 by 12 by 11 cm., was found growing forwards from the posterior ribs on the left side of the chest, spreading across almost to the right ribs, and displacing the heart and lungs forwards. The histological structure was of a chondroid tissue relatively poor in cells, consistent with a very slow rate of growth, but some parts of the tumour were more cellular, and one small metastasis was found in one lung. It seems possible that this tumour may have been growing slowly since the time of the suspected rib fracture. The other four rib tumours were classified as osteosarcomas (Figs. 9 and 10) in three cases (10, 11, 12), and as an osteochondrosarcoma in one case (13). Some of the bone formed was apparently periosteal and not neoplastic in origin.

Femur

One of the five specimens (case 19) was classified as a chondrosarcoma; the neoplastic cartilage was not very cellular and appeared to be less differentiated than normal. The tumour was growing in and destroying the bone in the outer condyle of the left femur of the 9-year-old Retriever dog affected (Figs. 11 and 12). The other tumours were cellular sarcomas. The cells were spindle-shaped, stellate, or osteoblast-like, and in three of the tumours there was an atypical osteoid material, which was heavily calcified in parts. On the left femur of a 5-year-old Great Dane bitch (case 15) the periosteum, particularly above the level of the tumour, showed a marked production of new bone, especially in front of the shaft (Figs. 13 and 14).

Radius

In the four affected animals tumours were situated near the lower ends, and appeared to arise first in the diaphysis and to spread later to the epiphysis. There was a variable destruction of bone by the tumours and considerable periosteal bone formation. The tumours were generally cellular osteosarcomas, the cells being spindle-shaped, stellate, or polygonal. In two specimens (21, 23) a fair amount of calcified matrix was present. Of particular interest is a case of sarcoma of the lower end of each radius of a 6-year-old male Great Dane (case 22). This animal had an increasing swelling just above the carpus of each fore-limb (Fig. 15) for some six weeks before X-ray examination (Fig. 16) and consequent destruction. Osteosarcomas were found at the lower end of each radius (Fig. 18); the tumours were cellular in nature, the cells being large and tending to be spindle-shaped, with a fair amount of osteoid matrix (Fig. 17), which in places was calcified. The layout of the non-neoplastic bone formed by the periosteum (Fig. 19) was well shown in a radiograph of a slab of tissue prepared by Dr. H. A. Sissons (Fig. 20), and appearances suggesting intermittent periosteal activity (Sissons, 1949) could be observed. No macroscopic metastases were found in the regional lymph nodes nor in the lungs, and none were detected radiographically in the other limb bones, so that these two osteosarcomas appear to be independent primary growths.

XUM

Tibia

A spindle-celled sarcoma of the lower part of the right tibia of a 10-year-old mongrel dog (case 26) was diagnosed from a radiograph and from a biopsy specimen; no post-mortem examination was possible. The other two tibial tumours were osteosarcomas, showing in one case moderate (25) and in the other considerable amounts of osteoid matrix. This latter tumour (24) in a 3 to 4-year-old Greyhound dog had caused considerable destruction of bone at the lower end of the tibia, with much local hæmorrhage, but the articular cartilage appeared to be intact (Fig. 21). In an 8-year-old Great Dane bitch (25) cartilage as well as bone was being produced by the periosteum.

Miscellaneous Tumours

The tumour of the scapula (case 27) of a 7 to 8-year-old Retriever dog was an osteosarcoma, that of the ethmoid of a 10-year-old Alsatian bitch (case 30) was a chondrosarcoma. A tumour (case 28) in a 10-year-old mongrel dog was an osteosarcoma which was apparently arising from the ulna. The tumour cells were accompanied by patchy areas of osteoid matrix, which was partly calcified. A number of osteoclasts were present. When this animal was first examined radiographically most of the ulna had been destroyed by the tumour, and six months later both the radius and the ulna had been practically replaced by the tumour (Figs. 23 and 24). There was almost complete destruction of the ulna in cases of sarcomas of the bone described by Claassen (1936) and Schnelle (1937). The phalangeal osteosarcoma (case 29) in a 9-year-old cross-bred Spaniel (Fig. 22) showed a pleomorphic cell structure, including numerous giant cells, in the pulmonary metastases, while the local lesion was composed mainly of spindle-shaped cells which were separated by irregular and sometimes bar-like areas of pink-staining matrix, along with a number of small osteoclast-like cells.

Differential Diagnosis

The final diagnosis of primary sarcoma of bone can be made only by full pathological examination post-mortem, and some of the cases recorded in the literature are deficient in this respect. However, a limited study of dogs affected with other neoplasms has suggested that secondary tumours are not often found in the limb bones, although some tumours, thought from clinical examination to be primary tumours of bone, have been found in fact to be secondary. For example, a lesion of the right olecranon process of a 9-year-old cross-bred Retriever dog appeared to be a secondary deposit of a carcinoma of the thyroid, and in a 16-year-old mongrel bitch with a carcinoma of the left thyroid gland there was a metastatic deposit in the head of the right humerus. Metastases from a malignant melanoma alongside the prepuce of a 7-year-old Airedale dog were present in many limb bones, including the head of the humeri, and in the vertebræ. A lesion in the upper end of the right humerus of a 9-year-old cross-bred Bull Terrier bitch proved to be a metastasis of an adenocarcinoma, probably of mammary origin. It seems that lesions in the upper end of the humerus particularly should be considered carefully in trying to assess their primary or secondary nature.

XUM

Claassen (1936) described metastases of a mammary carcinoma in the left radius and right ulna of an 11-year-old bitch. Schnelle (1937) published a radiograph which was said to show metastatic prostatic carcinoma in the limb bones of an 11-year-old Airedale dog; however, the radiographic picture shown is indistinguishable from that of hypertrophic pulmonary osteo-arthropathy, and it is not clear whether the prostatic carcinoma was demonstrated histologically in the bones. Schnelle further stated that his "X-ray files show three cases of metastatic carcinoma two of which were primary in the prostate and in the third case no autopsy is recorded but the radiographic appearance is similar to the other two." These cases are of great interest from the viewpoint of comparative pathology.

In only one dog examined in the period during which these thirty sarcomas were encountered was a lesion seen which was diagnosed as a non-neoplastic fibrous bone dystrophy. This lesion affected the right turbinate bones of a 4-year-old St. Bernard bitch. Histologically, there was more fibrous tissue than in the usual osteosarcomas, with local areas of osteoid or bony material, and groups of osteoclasts. The affected bones were more or less uniformly expanded. No examples of conditions of the type of multiple cartilaginous exostoses, multiple enchondromata, or osteitis deformans (Paget's disease), as seen in man, were recognised. Further, no benign tumours of bone, such as chondroma, benign giant-cell tumour, benign chondroblastoma, chondromyxoid fibroma, myxoma, or fibroma, were seen.

Summary

In a series of thirty primary tumours of bone from dogs, all were sarcomas, with a variable production of a matrix which more or less closely resembled that of bone or cartilage. The favoured sites of tumour formation were the upper part of the humerus (9 cases), the ribs (5 cases), and the lower parts of the femur (5 cases), radius (4 cases, one with bilateral primary tumours) and tibia (3 cases). Metastases were present in 12 and perhaps in 14 cases. Some at least of the sarcomas of the limb bones appeared to have originated centrally, but there was a tendency for them to destroy the compact bone of the shaft locally, and to spread externally. There was often a considerable production of non-neoplastic bone by the neighbouring periosteum.

Acknowledgments

My thanks are due to Mr. G. C. Knight and his colleagues in the Beaumont Animals' Hospital and to other veterinary surgeons for their help in providing material and in other ways and to Dr. H. A. Sissons for Figs. 18 and 20.

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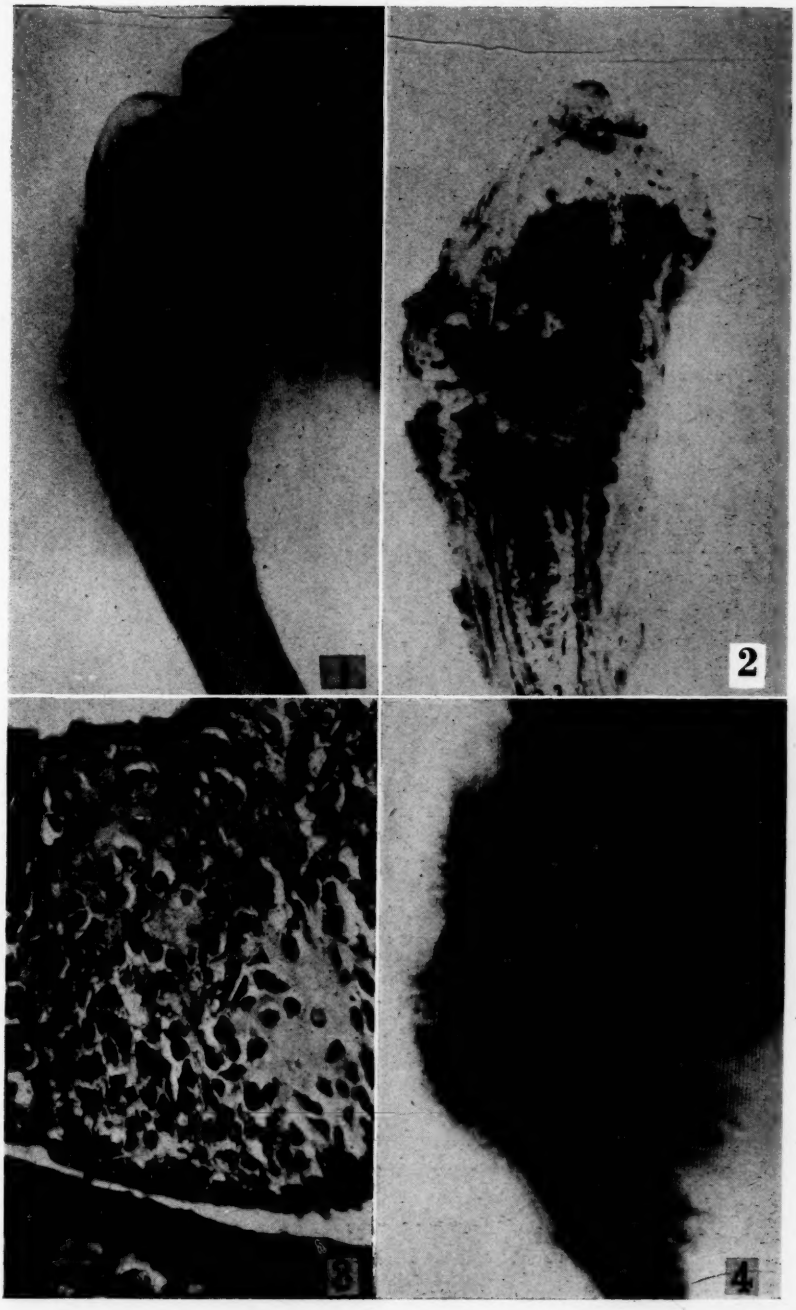
PLATE I



Figs. 1 and 2: Radiograph and sagittal section of an osteosarcoma of the humerus (Case 4), showing destruction of cortical bone, and periosteal bone proliferation.
Fig. 3: Histological section of metastatic lesion in a pulmonary blood vessel from an osteochondrosarcoma of the humerus (Case 8).
Fig. 4: Radiograph of an osteosarcoma of the humerus (Case 2), showing a pathological fracture.

(*Article by Cotchin, page 248*)

PLATE II

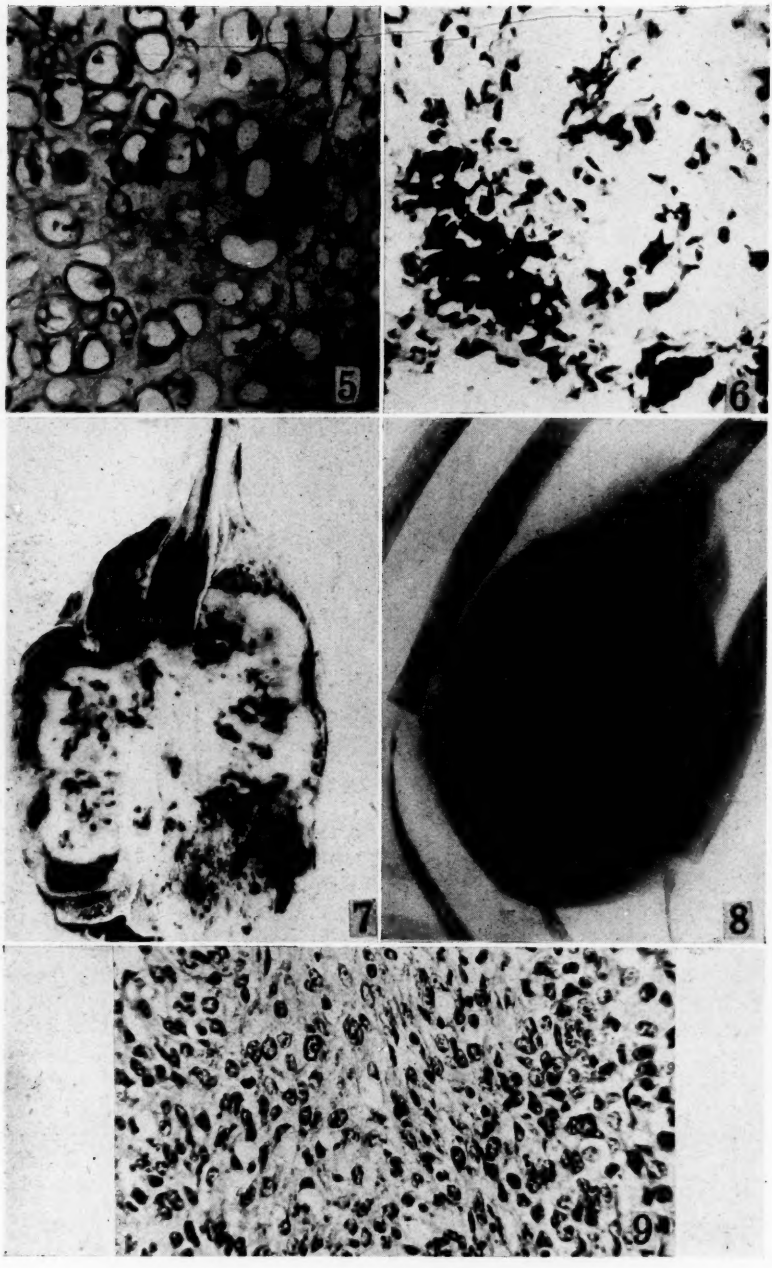


Fig. 5: Histological appearance of cartilage in an osteochondrosarcoma of the humerus (Case 3).
Fig. 6: Section showing calcified matrix in an osteosarcoma of the humerus (Case 1).
Fig. 7: Cut surface of an osteosarcoma of a rib (Case 10).
Fig. 8: Radiograph of an osteosarcoma of a rib (Case 12).
Figs. 9 and 10: Histological appearances of an osteosarcoma of a rib (Case 10), showing spindle-cells (Fig. 9) and atypical bony matrix (Fig. 10).

(*Article by Cotchin, page* 248)

XUM

Figs. 11 and 12: Radiograph and coronal section of a chondrosarcoma of the femur (Case 19).
Figs. 13 and 14: Radiograph and sagittal section of an osteosarcoma of the femur (Case 15).
Fig. 15: Great Dane with an osteosarcoma of the lower end of each radius (Case 22).

(*Article by Cotchin, page* 248)

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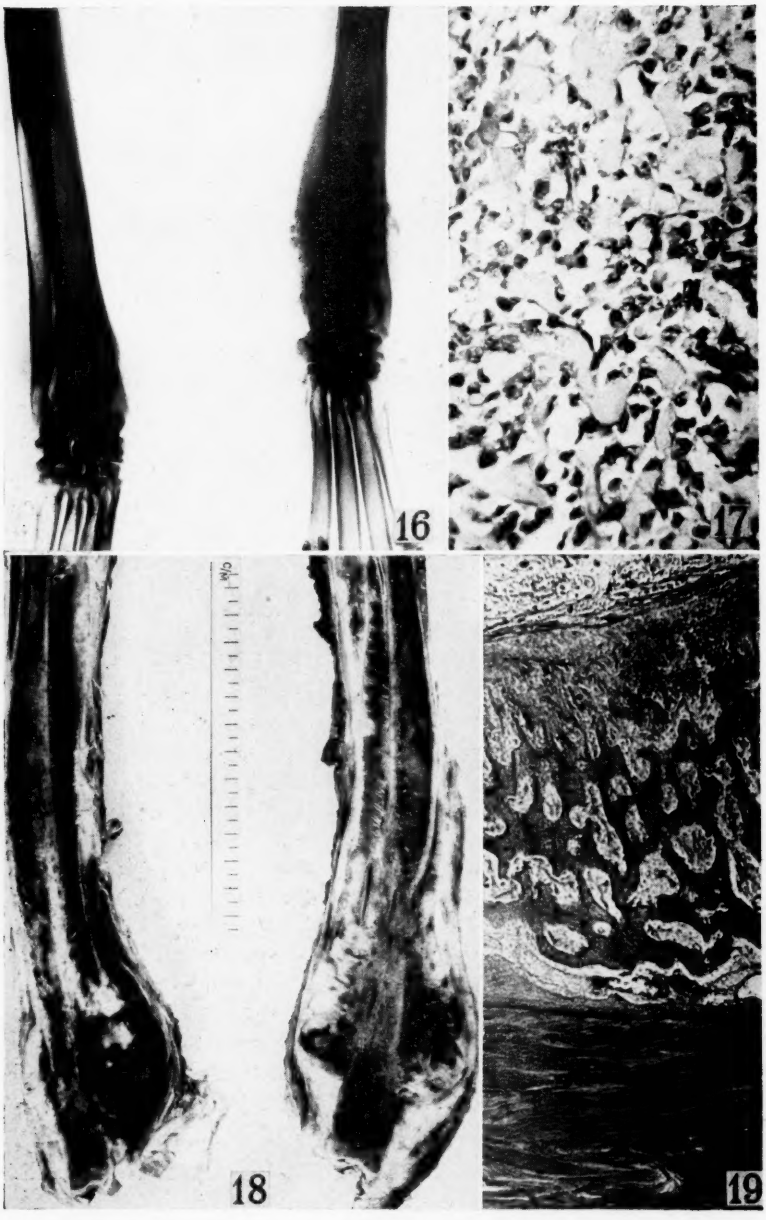

Fig. 16: Radiographs of the affected bones of the Great Dane (Case 22). The left radius is shown on the right.

Fig. 17: Histological appearance of the osteosarcoma of the left radius (Case 22), showing osteoid matrix.

Fig. 18: Sagittal sections of the osteosarcomas of each radius (Case 22); the left radius is shown on the right.

Fig. 19: Histological section of the periosteal bone proliferation accompanying the osteosarcoma of the left radius (Case 22).

(*Article by Cotchin, page* 248)

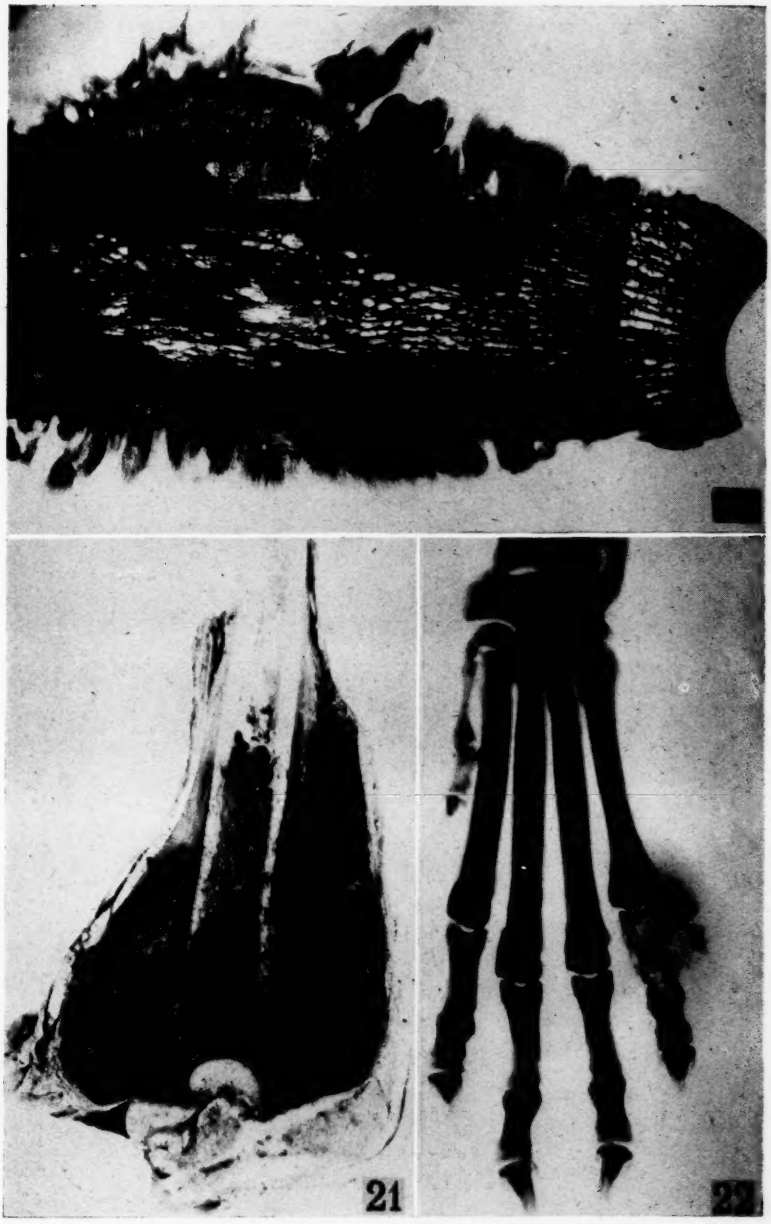

Fig. 20: Slab radiograph of the osteosarcoma of the left radius (Case 22), showing the periosteal bone proliferation.
Fig. 21: Sagittal section of an osteosarcoma of the tibia (Case 24).
Fig. 22: Radiograph of an osteosarcoma of the fifth left proximal phalanx (Case 29).

(*Article by Cotchin, page* 248)

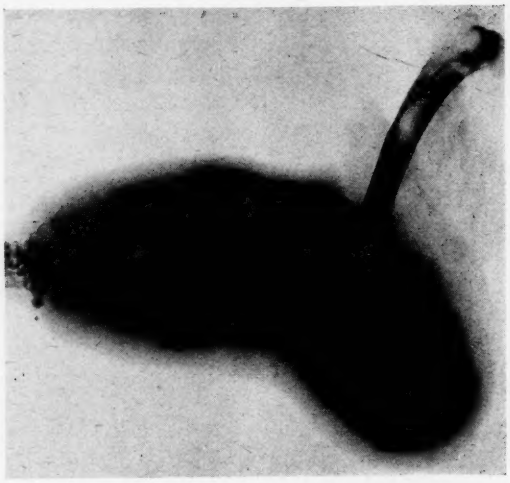

Fig. 23

Fig. 24

Figs. 23 and 24: Radiograph and sagittal section of an osteosarcoma which originated in the ulna (Case 28) and eventually replaced both the ulna and the radius.

The histological sections were all stained by hæmatoxylin and eosin, and are shown at a magnification of x 320, except for Fig. 19 (Case 22), which is x 32.

(*Article by Cotchin, page* 243)

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MIGRAM: A DISEASE OF SHEEP ON THE ROMNEY MARSH

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Introduction

In the September of 1942 during an investigation into diseases of sheep on Romney Marsh, a condition known locally as "Migram" was encountered. It was characterised by occasional tetanic-like convulsions and varying degrees of delirium. The actual cause was unknown, and as far as could be ascertained, there was no previous written record of the disease. Mild cases were known to occur in sheep and cattle during very dry weather in the winter and summertime, and the farmers related this to lack of food and water. More severe outbreaks, as in 1940, when hundreds of sheep were involved, occurred during very hot, dry weather in the summertime when the grass was very short and dry and fresh water scarce. The sheep were obliged to drink salty water from sea water-contaminated ditches. The symptoms of the disease did not coincide with those generally ascribed to salt-water poisoning. However, from experiments carried out in the area, and the perusal of literature relating to the subject, I am of the opinion that the disease is a chronic dehydration.

Data regarding the incidence of the disease over the past 14 years and details of experimental treatment, together with a report on a control experiment, are included herein.

Description of "Migram" Area

The part of the Marsh where most cases occurred and the disease was studied is called Lords Land, East Guldeford. It is situated about one mile from the higher mainland in the north and three miles from the sea in the south, with an uninterrupted view of both owing to the lack of trees and hedges and the level surface of the marshland. It has been grazing land for sheep for a

XUM

great number of years and is grazed all the year. The grasses are mainly natural perennial rye grass, "squirrel-tail" and wild white clover. There is no lush pasture and the fields have the appearance of mown lawns. Subsoil analyses indicate high potash and medium high phosphate. About 80 acres in extent, the area is divided into three fields by three waterways, two of which are salty and arise via the Union Channel from the River Rother, and the third is a rain-water ditch called the Longfield or Union Petty Sewer. Every field has a rain-water ditch or pond. The Rother is separated from the Union Channel by a lock and there are locks separating the Channel from the two salt-water ditches which are called Five Watering Sewer and White Kemp Sewer.

Chloride content of waterways for September-October, *1943* and *1947*

Union Channel	chloride mg. p.c.		...	...	1,400	1,444
Five Watering Sewer	,,	,,	...	...	848	462
White Kemp Sewer	,,	,,	...	...	722	452
Union Petty Sewer	,,	,,	...	...	25	20

Incidence of the Disease

1939: 10 sheep affected (1.6 per cent). Tegs, ewes and lambs. No deaths. Fair amount of grass but fresh-water ditches dried up and sheep drank from salt-water ditches. Winds variable, light to moderate. Temperature during summer months averaged 60 deg., and rainfall 1.5 inches.

1940: 350 sheep affected (50 per cent). Tegs, ewes and lambs. 150 died. Occurred too early to be lack of green food. Grass grew very fast in the spring but about the beginning of May the weather changed and there were a lot of east winds which kept everything very dry throughout the summer. The fields were heavily stocked and the water supply in the fresh-water ditches was soon exhausted. On May 27 the salt-water ditches, which were nearly dry, were filled with sea water by order of the military authorities in order to act as an anti-invasion measure. The sheep began to drink from these ditches and in a period varying from two to three weeks symptoms of "Migram" appeared. The weather was moderate.

1941: 15 sheep affected (3 per cent). Tegs, ewes and lambs. No deaths. Fair amount of grass and the fresh-water ditches held better. Weather moderate but very wet in August.

1942: 54 sheep affected (9 per cent). Ewes and lambs only. 8 died. Fair amount of grass but the fresh water went early, and during July the sheep began to drink from the salt-water ditches. Early in August a lot of sea water poured over the locks into those ditches for about four hours daily for four days. The sheep continued to drink the salt water and during the latter part of August symptoms of the disease appeared. The weather had been moderate during the summer. There were some showers in September and the disease had cleared up by the middle of October.

1943: No symptoms. The fresh-water ditches had been cleaned out and a plentiful supply of fresh water was available all the summer. There was very little keep and the weather during July and August was very hot and dry.

XUM

1944: No symptoms. Conditions were very similar to 1943.

1945: No symptoms.

1946: No symptoms. A wet summer.

1947: 90 sheep affected (16 per cent). Tegs, lambs and young ewes. 37 died. There had been an enormous amount of rain and snow during January and February and the ditches were well filled. In April and May the grass grew very fast, the weather was variable with a fair amount of rain, whilst in June the weather was fine and warm with occasional showers and by the end of the month the sheep were getting above the grass. In July it was very hot with very little rain and the grass was getting very short; the land was drying out quickly. The last real rain was in July and by the end of the month the grass was dried brown. The air was very dry all through the summer. During August the wind was east-north-east and the weather hot and this continued until the middle of September. It was noticed that the sheep and even the lambs at one month were drinking from the sea-water ditches throughout the year. This was probably due to the fact that the salt had been well diluted during the early months and also because these ditches held the water at a higher level and were easier to reach. Symptoms were first noticed about the middle of August and it was not until November that the last case cleared up. Tegs were first to show signs and then lambs and these were followed by the young ewes.

1948: No symptoms. Plenty of grass and rain.

1949: 10 sheep affected (1.4 per cent). Tegs. No deaths. Fairly normal summer and moderate amount of grass. Affected sheep had been drinking from the White Kemp Sewer which was stagnant.

1950: No symptoms. Average grass and weather conditions.

1951: No symptoms. Average grass and weather conditions.

1952: 12 sheep affected (2 per cent.) Tegs, lambs and young ewes. No deaths. Weather moderate until July and then cold east winds. The land was heavily stocked and grass was short. Symptoms noticed about the end of July. Although there was a moderate amount of fresh water available, the sheep were drinking freely from both fresh- and salt-water ditches. The salt-water sewer water was opaque and similar in colour to tea with milk. Analysis proved that it was quite safe for animals to drink; the salt content was average, and the opacity was considered to be due to some fish reaction. Three badly affected animals were isolated and given fresh water to drink. They recovered in two to three weeks. September was cool and showery and the disease disappeared.

Symptoms

The earliest sign of the disease is exhibited when the flock is made to move on or hustled. Several sheep will be noticed lagging behind in a depressed manner and when these are further stimulated they will commence to hurry and start to demonstrate one or the other of the following types of nervous reactions:

(1) Sudden opisthotonos with knuckling of the hocks, fetlocks and sometimes the wrists, and the animal sinks quietly to the ground. There is no

XUM

struggling and if it is not disturbed it will remain in this position for a few minutes, when it will rise and walk with an unsteady gait, but without stiffness, for about 50 yards and then appear quite normal. If it is hustled in the slightest during this walk it will repeat the same cycle.

(2) Trots with an increasingly stiffening gait, its hind legs become quite stiff as if tethered and are dragged behind as the belly sinks to the ground, whilst the front legs continue to struggle forward. When it realises the futility of movement it lies quietly until the seizure has passed and then it rises and walks almost normally to rejoin the flock. If it is hustled at this stage it will repeat the performance and sometimes finishes up on its side dithering.

(3) Sudden knuckling of the wrists with emprosthotonos and complete somersaulting, once or twice. Or pleurothotonos with dithering of the updrawn hind legs for a variable period up to one minute. It will then become normal and quietly join the others unless disturbed when it will repeat the same symptoms.

A recovered sheep will often stand with its hind legs fairly wide apart and sway its body for some minutes. Repetition of the symptoms at intervals during the day do not appear to have any marked detrimental effect, even if the illness lasts several weeks. It was noticed that the degree of hypersensitiveness varied in different sheep, but it was not possible to relate this to the degree or duration of illness. For instance, in some cases it was necessary to hustle the patient before symptoms were demonstrated whilst in others a small external object such as a piece of paper blown by the wind across the path of an affected sheep would be a sufficient stimulant. Sometimes in descending the bank of the ditch a sheep would slip, stumble or splash the water with its foot and that would be sufficient to stimulate a seizure. It would fall into the water, enact its own peculiar symptoms, usually with its head under the water, and die from drowning. A number of sheep were found dead in the ditches, their bodies resting on the bank and their heads in three inches of water. *All the deaths were by drowning.*

When left quietly alone the sheep appeared normal in every respect, grazing, resting and chewing the cud. Only when it was very hot and dry would they congregate along the ditches and it was usually during the middle of the day that most symptoms were observed. Except during a seizure there was no panting and there was never any nasal discharge, vomition or diarrhœa.

Blood examinations were made on eight sheep suffering from the disease in different parts of the area. Chloride content was found to be from 280 to 320 mg. per cent, and that for calcium, magnesium and hæmoglobin was also within the normal range.

Post-mortem examinations were carried out on four sheep recently dead from the disease and apart from the water in the lungs, no abnormal conditions were found. Unfortunately, no histological or chemical examinations were made.

Tolerance

Sheep would partake of the salt water for several weeks without showing any material loss in condition or increase in the severity of the symptoms, but if they were obliged to drink it for a period approaching three months there was

XUM

a loss in condition but no permanent damage was done except in the case of one or two sheep which developed an abnormal appetite for it and preferred it to the fresh water. These sheep were found, later in the year, to be undersized and ill-nourished and a sample of blood from one which weighed about two-thirds of the normal showed no abnormal levels except a low hæmoglobin. It was kept under observation for three weeks, during which time it drank voluntarily about one quart of 1.48 per cent salt water daily whilst grazing under normal conditions with fresh water available, which, however, it did not touch. It appeared mentally abnormal in that it wandered aimlessly round the field when other sheep would be grazing and sometimes walked into gates although it was not blind. A further sample of blood was taken at the end of the period but the values found were the same. As the animal was losing condition rapidly it was slaughtered and a post-mortem examination revealed the only lesion to be a massive infestation with the roundworm *ostertagia ostertagia* in the abomasum and numerous whipworms in the cæcum.

The sheep on the Marsh are dosed for worms at regular intervals throughout the year and it is very improbable that they could be considered susceptible to disease in relation to their worm content.

Recovery from the disease was noticed ten to fifteen days after heavy rainfall had replenished the fresh-water ditches and revitalised the grass, and also if a sheep was isolated from the salt water and given fresh water to drink during hot, dry weather.

Diagnosis

A tentative diagnosis in favour of dehydration was based on the following facts:—

(*a*) Sheep do not drink water if there is plenty of moisture in the grass;

(*b*) If they have to drink, they prefer fresh water, but soon adapt themselves to salt water and take it readily;

(*c*) In the average "migram" year the disease occurs about August when the keep is short and the weather dry. Mild cases are definitely associated with shortage of keep and aggravated by lack of water;

(*d*) In 1940 the severe outbreak occurred in the middle of June when although there was plenty of grass, the winds had made everything dry, including the fresh- and salt-water ditches. These latter ditches had been filled with sea water on May 27 and the sheep were soon drinking from them.

Differential Diagnosis

In some respects the symptoms of "Migram" might be confused with nervous symptoms in other diseases of sheep, as quoted below. Sufficient proof to differentiate it from such other diseases is that the administration of fresh water to a "migramy" sheep whilst it is still grazing in the affected area results in complete recovery.

XUM

Disease	*Incidence*	*Symptoms*	*Treatment*
Parturient Hypocalcæmia	Found only in ewes. Rapid course.	Extension tetany. Excitement and coma.	Calcium.
Pregnancy Toxæmia	Ewes (pregnant). Death in 1 to 6 days.	Staggering gait. Fine tremors.	? Glucose.
Swayback	Lambs.	Ataxia and a straddled gait.	? Copper.
Cœnuriasis	Isolated cases.	Characteristic. Hypersensitive. Circling, high stepping, jerky gait.	Removal of cranial cyst.
Scrapie	Sporadic in flock. In 18 months or older and due possibly to filterable virus.	Lasts 14 days to six months. Nervousness. Rapid nodding and muscular tremors. Head and neck held high and stiff. Thirst. Pruritus. Convulsions if stimulated and coma.	None.
Louping-ill	Mainly on rough pasture and hill country. Due to tick-borne virus.	Dullness, fever, excitability, muscular spasms, irregular gait, loss of balance and later paralysis of one or both hind legs.	Vaccine for prevention. No specific curative.

Treatment (1947)

Based on the farmer's history of recovery in affected sheep, and the obvious thirst of the animals, it was considered feasible that isolation from the salt water and access to fresh water should facilitate recovery. An odd field of three-quarters of an acre that had no water supply of any kind was used as an isolation area. It was divided from the other fields by an ordinary fence and there was very little grazing to be had. Sixteen affected sheep were placed in this field on September 12 and given the tops of mangolds to supplement the grazing. Fresh water was brought from the house and each sheep received approximately half-gallon daily. Eight days later a further 14 affected sheep were brought into the field and treated in the same manner. On September 27, 14 of the first batch were considered nearly cured (15 days' treatment) and they were transferred to a small plot of grassland adjacent to the house where there was some fresh water in a pond and salt water in a sewer. No fear was felt regarding any possible drowning as the sheep were so improved. There was a fair bite of grass and no supplementary food was given. Eleven days later they were considered normal, no seizures having occurred during that period, and as the plot was needed for a further batch from the isolation area, they were allowed to rejoin the flock. Another 12 of the affected sheep had recovered during treatment (18 days) and these were transferred to the house plot and a week later rejoined the flock. Of the four remaining in the isolation area, two were normal by October 24 and the others by November 4. From the beginning of the treatment special care was taken to compare the condition of the sheep in the various fields, and it was noticed that on September 12, after the 16 sheep had been isolated, there were 38 other cases in different fields. On September 20, when the second batch went into isolation, there were 40 affected sheep showing symptoms in the

other fields. When the 26 recovered sheep were allowed back in the flock on October 15, there were still 40 affected sheep at large and they continued to demonstrate symptoms until early November. None of the recovered sheep had a relapse and they appeared to have suffered very little inconvenience as a result of the illness. By the middle of November there was no sign of the disease, and the sheep which had recovered without treatment were showing some loss of weight and condition. In 1949 four affected sheep were placed in the isolation area and given fresh water and no extra food; they recovered in 15 days.

Water Intake

In sheep, Giuliani (1939) found that on fresh pasture no water was required, but on dry pasture, in cold weather, they drank up to 4.0 litres daily and in summer-time five to six litres.

Hindmarsh (1939) says that the amount of water drunk by sheep grazing on pasture in Australia varies inversely with the rainfall. When there is little or no rain they drink about one gallon daily.

In experiments carried out by Wallace (1944) it was found at the height of summer that the ratio of dry matter to water consumed was approximately 1 : 4.8. His ewes were confined in pens in a shed with the front exposed to the weather and were fed on hay alone or with concentrate mixtures. Their water intake was two to three times as much in hot as in cold weather.

According to the shepherds on the Romney Marsh, sheep which have only grass to eat may not drink for several days in normal wintry weather, whereas during the heat of summer it is quite common to find as much as four gallons being an average intake per sheep. This quantity is carried to the animals in two-gallon buckets.

Dehydration

This is a condition of the body in which there is a marked loss of fluid-containing solutes. It is a common sequel to prolonged vomition, diarrhœa, diuresis or profuse perspiration. There is an increase in the concentration of sodium and chloride in the extracellular fluid with a consequent withdrawal of water from cells. This is further aggravated following excessive salt intake and the alteration in the osmotic pressure of the body fluids is generally accepted as the cause of the nervous symptoms in salt poisoning.

Lee and Robinson (1941) found that in sheep the evaporative water loss in a hot, dry room prior to shearing was 62 gm./hour and after shearing 69 gm./hour, the respired volume being 20 gm./hour, showing that the evaporation was not merely that of water stored in the fleece. Sweat glands have been found over the body of the sheep (Dukes, 1937) so that increased insensible cutaneous evaporation and sweating could probably account for the difference. They state that the sheep appears to be outstanding amongst domesticated animals in tolerating hot atmospheres, indicating a high development of its heat regulatory mechanism. The thick fleece may be of advantage in a hot, dry atmosphere, forming a protective layer. The only visible effect of heat on the sheep was shown in its respirations which increased with rise of rectal temperature

XUM

above 103° F. When this reached 106° F. the rapid respirations of about 240/minutes changed to panting with mouth slightly open and tip of tongue protruding. It kept its lips moist by licking and dipping in water and exercised its tongue, causing a movement of air over the moist surface. There was a disturbance in its equilibrium when the room temperature reached 90 to 95° F.

Salt Poisoning in Animals

Steyn and Reinach (1939) describe the symptoms in an acute case as: diarrhœa, vomition, tympany and clonic muscular spasms; and in chronic as: chronic diarrhœa, partial loss of appetite, retarded and stunted growth, anæmia, general weakness, reduction in productivity and fertility and an increased susceptibility to worms and to the effects of droughts. They quote a description by Legg (1929) of poisoning in sheep which drank rain water which had collected in salt troughs and the animals developed dullness, straining, pronounced diarrhœa and thirst.

Heller (1933) records the following symptoms in adult pigs which had been consuming a 1.5 per cent solution of sodium chloride for 30 days: a slight stiffness of the limbs when walking, restlessness, nervousness, refusal to drink and loss of appetite. Some small pigs died. When the live pigs were removed from the salt water and given pure water to drink they were practically normal in ten days.

Moule (1945) describes the following symptoms observed in 3,000 sheep which had watered at a trough associated with a subartesian bore and which contained 1,650 grains of salt per gallon compared with a normal 420 grains per gallons: scouring, staggering gait suggestive of marked weakness, muscular spasms, twitching and struggling when down, possibly indicating abdominal pain. Soon after watering they had been loaded on trains. Sixty-two died.

Blaxland (1946) and Doll *et al.* (1946) give a very similar picture of salt poisoning in young chicks. Some were somnolent whilst other showed nervous symptoms: opisthotonos, convulsions, inco-ordination, inability to stand and occasionally giving spasmodic jumps into the air.

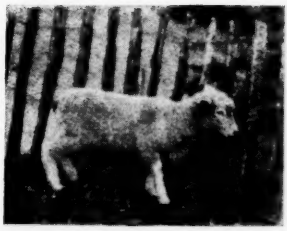
Wilkinson (1952) records salt poisoning in puppies and states that the main toxic effects appear to have been on the spinal nervous system, producing ataxia and paralysis of the limbs.

Heller (1933) experimented with healthy sheep. He fed them on dry food during six weeks in winter-time and with a 2.0 per cent sodium chloride solution to drink, and they maintained and even increased their weight, but were off their feed at times. For six weeks in the summer-time, with only salt water to drink, they consumed 1.17 gallons of a 2.0 per cent sodium chloride solution per day and lost weight. One of them died on a very hot day.

Experimental Work

In the autumn of 1943 an experiment was carried out to show the effect of water from the White Kemp and Five Watering Sewer on sheep grazing under normal conditions and when none of the predisposing causes of a natural outbreak were in evidence.

The animals used were two Romney Marsh wether tegs of the same age



Type (2a)
A disturbed sheep, lagging behind flock. If left alone it will apparently recover.

Type (2b)
Stiff-legged progress with a lengthening stride in the hind legs.

Type (2c)
Critical stage, the hind legs stay behind as if tethered. The front legs progress and the animal sinks to the ground.—See (2d).

Type (2d)
Final stage of this type. Note the central figure demonstrating Type (2a).

Type (3)
Completion of somersault. Sheep facing away from original direction.

(*Article by Chesney, page 257*)

XUM

which had been brought into the "Migram" area during the spring of that year and had originated from the same flock. Both appeared in perfect health and had been drenched with nicotine and copper sulphate worm mixture several times during the year—the last drenching was at the end of the summer. One was slightly larger and in a little better condition than the other and so for convenience they were called large and small ("L" and "S") respectively. They weighed approximately 80 lb. and 60 lb. and had not suffered from the disease.

For the purpose of the experiment they were confined to a grass compound. It was about three-quarters of an acre in area with perennial rye grass which remained at a fair level throughout the experiment. They had no access to water and could not get out of the compound.

For the first 20 days they were drenched daily with water from the White Kemp Sewer and for the last 26 days with water from the Five Watering Sewer.

The amount which each sheep would swallow depended to a large extent on the weather conditions, e.g., if there had been heavy showers during the hours which immediately preceded the drenching or if the weather was very cold or raw then the intake of salt water dropped to between one and two pints. In very raw weather both sheep, after the drenching, would shiver for as long as half an hour and refrain from grazing for about an hour.

The large sheep "L" showed an initial dislike for the salt water every time it was drenched although after the first few mouthfuls it would take from two to six pints without any fuss but, as a rule, when four pints had been swallowed it began to object and the drenching was stopped. It would then commence to graze normally.

The smaller sheep "S" disliked every mouthful it was forced to swallow throughout the experiment and the greatest amount it would swallow at any time was $2\frac{1}{2}$ pints. After almost every drenching it stood depressed and disinclined to move for about ten minutes and would then become normal and start to graze.

Throughout the weeks of drenching neither sheep showed any desire when offered fresh or salt water to drink. At the end of that time the smaller sheep had grown to be as big as the other and had increased its weight to about 70 lb., whereas the large sheep had lost a few pounds in weight. Both looked quite well although "S" appeared the better of the two. Weather conditions for September to December were as follows:—

	A.D.T.	*Rain*	*Wind*
September ...	66.4	2.30 in 11 days	Mainly W., light force
October	59.8	2.79 in 12 „	Mainly S.W., mod. force
November ...	46.1	1.74 in 15 „	N., N.W., N., N.E., mod. force
December ...	42.0	2.15 in 11 „	N. to N.E., mod. force

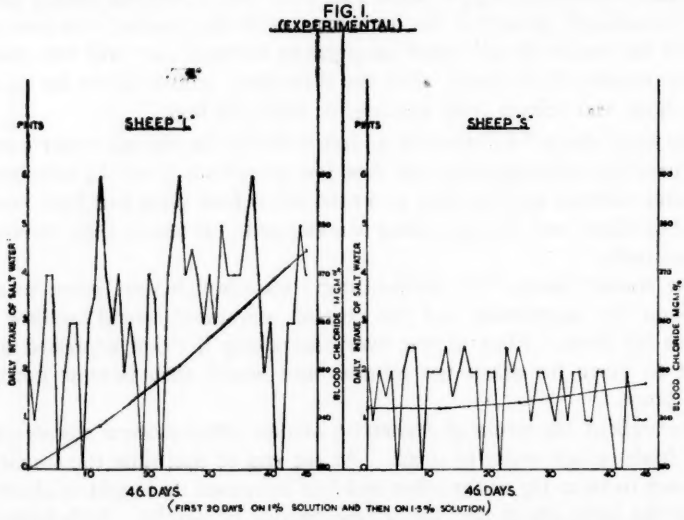
The rainfall was below the average and conditions generally were on the dry side. Winds were mainly light or moderate and the day temperature in September and October above the average, and in November about normal.

Blood samples were taken at intervals during the experiment and about seven weeks afterwards and the data obtained are as follows:—

	October 18th	31st	Nov., 1943 21st	Jan., 1944 11th	
Serum calcium mg. p.c.	10.6	10.5	10.4	10.2	"L"
Serum magnesium mg. p.c. ...	2.6	2.5	2.5	2.5	
Blood chloride mg. p.c.	338	351	376	330	
Blood hæmoglobin g. p.c. ...	—	9.3	8.7	9.8	
Serum calcium mg. p.c.	9.8	10.2	10.2	9.8	"S"
Serum magnesium mg. p.c. ...	2.2	2.2	2.4	2.3	
Blood chloride mg. p.c.	342	344	348	342	
Blood hæmoglobin g. p.c. ...	8.0	8.3	—	9.0	

(See Fig. 1)

The drenching ceased on November 21, i.e., on the 46th day. From that time until January 9, 1944, i.e., 50 days, the sheep received no salt or fresh



water to drink and when on the latter date they were offered first fresh and then salt water they ignored both. By that date "S" had not increased any more in weight and both sheep now weighed about the same, i.e., 70 lb. "S" was quite normal in appearance and definitely the fitter of the two, "L" having deteriorated in general condition since the drenching ceased. Final blood samples were taken at this time.

On January 21, 1944, the sheep, whilst still in the paddock, each received 20 grammes of phenothiazine worm medicine. On January 24 "L" showed a definite amount of pain in the abdomen with inappetance and a disinclination to move. The following day it was found dead and, unfortunately, no post-mortem examination was made. The owner's description of the carcass was

that it had every appearance of a "struck" sheep. This is a local term for a disease due to *Clostridium welchii*, type C, which causes an enterotoxæmia and sudden death. "S" showed no unusual reaction to the drug and was released from the paddock to rejoin the flock.

Throughout the whole of the experiment and the period up to the illness in "L" there had been no symptoms of "Migram" in either sheep.

Fig. 1 indicates the amount of salt water given daily and the blood chloride reactions of each sheep during the experiment.

To sum up. "S" had ingested about 34 pints of a 1 per cent salt solution in 20 days and about 40 pints of a 1.5 per cent salt solution in the following 26 days. It increased in weight and size, improved in condition and remained well. "L" ingested about 51 pints of a 1 per cent solution in 20 days and about 99 pints of a 1.5 per cent solution in the following 26 days. It had lost weight and condition. Throughout the experiment neither showed any nervous reaction or other symptoms typical of salt poisoning, although "S" had ingested 564 gm. and "L" 900 gm. of salt in 46 days. This is an indication that some other factor is necessary to produce the Migram syndrome and it is probable that exceptionally dry weather which occurs during prolonged frost in the winter and during the heat of the summer provides the necessary conditions to render sheep susceptible to the ingestion of salt water in the concentrations present in the sewers.

Conclusions

The early symptoms of salt poisoning in animals occur when the subject is in a normal state prior to the ingestion of abnormal amounts of salt. The fact that these symptoms are absent in "Migram" would indicate that the sheep have acquired a tolerance for the usual salt content of their sewers, when conditions are normal. Usually the salt water they imbibe is not of sufficient strength to provoke an aversion to it, and when they need a drink they take it from the easiest source, which is often a salt-water one. The onset of the disease is never very obvious, and the severity of the symptoms vary in accordance with the need for moisture. When the grass is very dry the sheep look for water and if this is not available in time, probably about 14 days, symptoms of "Migram" appear. If only salt water is available, then the sheep have probably been drinking it in increasing amounts. If the weather continues dry the salt content in the ditches will gradually increase in strength and the sheep will drink more of it and "migramy" sheep will be in evidence in daily increasing numbers. This dehydration is soon remedied by supplying fresh water to drink. The failure to reproduce the syndrome experimentally, when the predisposing factor of "dryness" was absent, tends to support the above hypothesis.

Summary

A condition found in the sheep in the Romney Marsh area, locally called "Migram," is described. The incidence of the disease is principally associated with a deficiency of moisture in the diet and the ingestion of salt water during hot, dry weather. The predominating symptoms are nervous and the condition

XUM

is cured by providing fresh water. Experimental administration of salt water over a considerable period during the autumn failed to reproduce the condition, a fact which supports the hypothesis that dry conditions, with or without hot weather, are essential predisposing causes.

Acknowledgments

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DYSPLASIA SQUAMÆ OSSIS OCCIPITALIS CONNECTED WITH THE PROTRUSION OF MANDIBLE INCISORS AND OTHER DENTAL ABNORMALITIES

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In the study of congenital malformations, two problems are highly important:—

(1) The cause and incidence of single malformations; and

(2) The influence of congenital local disorders on the other parts of the body and its connection with other malformations or abnormalities.

This second problem may be connected especially with medical and veterinary practice. The diagnosis and prognosis of multiple malformations and their relation to the clinical picture can present many difficulties.

In the case described below the most obvious feature during life was the mandibular protrusion. Colyer (1936) (p. 340-342) described two skulls of Canidæ with a protrusion of the mandibular incisors in non-chondrodystrophic breeds. Chondrodystrophic breeds are characterised by the developmental changes in the basal part of the skull, Weinmann (1942) (p. 147). These changes

XUM

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FIG. 1
The position of the maxillar canine and mental foramen.

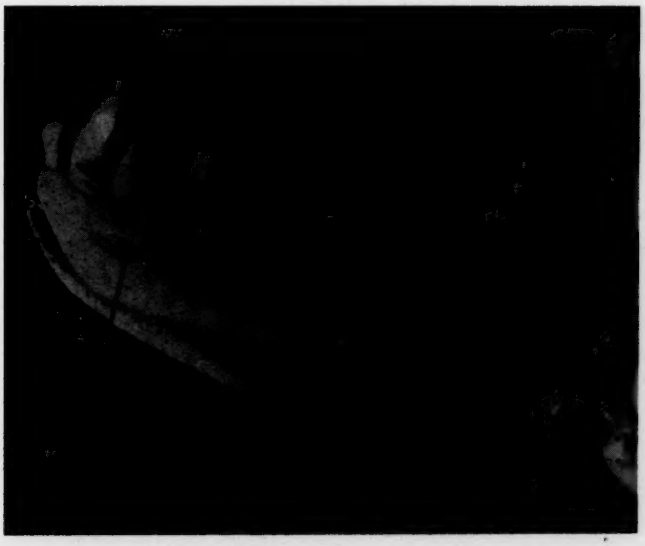

FIG. 2
The position of the maxillar canine and mental foramen in the normal dog.

(*Article by Tucker, page* 268)

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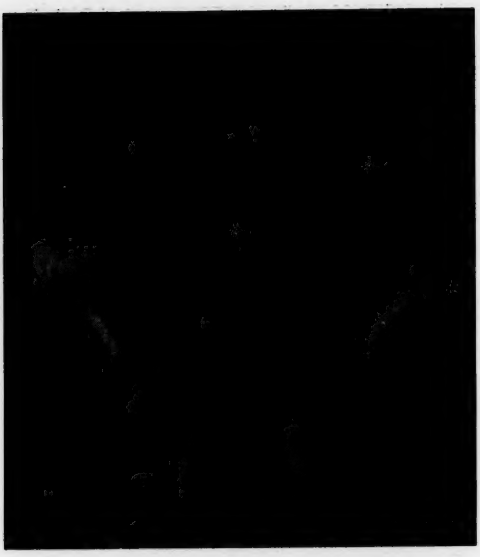

FIG. 3
The occipital squama.

FIG. 4
The absence of the first mandibular premolar on the left side. The arrow points to the diastema.

(Article by Tucker, page 268)

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in the rate of ossification of the synchondroses are due to the peculiar proportions between skull and mandible, as well as to other relational changes. In the examples given by Colyer, one skull is of a fox terrior and the other of a " parish dog." Another example, of protrusion of the mandibular teeth in *Canis latrans* is recorded by Lawrence (1934).

In the specimen described, that of a Pomeranian dog without a morbid history, the abnormal attrition due to the protrusion had advanced to marked extent. It occupied the ventro-anterior part of the teeth. The I_1 of both sides shows the attrition of its anterior part from apex to neck. In the second pair of incisors the attrition is of lesser extent. In I_3 posterolateral attrition is present. It is evidenced by a deep groove which reaches from apex to collum. In the mandible, the I_1 and I_2 show apical, anterior and posterior attrition. The greatest changes are in the posterior part of the teeth. I_3 has chiefly posterior attrition. Both canines demonstrate a sulcus-like attrition on the anteromedial faces. It makes the crown of the tooth very thin, long and sharp. In the left mandibular ramus the first premolar and last molar are absent; in the right ramus the last molar is absent.

The occlusion of molars and last premolar is normal; that of incisors, canine and anterior premolars, abnormal. The mental foramen is situated on the level of the maxillar canine (Fig. 1).

The junction between the supra-occipitale and exo-occipitalia is not complete (Fig. 3). A large square foramen is situated above the occipital foramen and is higher on the right side than on the left. The foramen was covered by a thin membrane. The impression on the internal face of the occipital bone was relatively deep. The supra-orbital process of the frontal bone, part of the nasal and maxillar bones, as well as the margins of the orbits are osteoporotic.

Discussion and Conclusions

The position of the incisors in the alveoli as well as the position of the mandibular alveoli is normal. The protrusion is due to the elongation of the mandibular body. In view of the changes in the mandible, the position of the mental foramen is characteristic (Fig. 1). In the normal dog's skull the mental foramen is situated on the level of the first maxillar premolar or even a little more posteriorly (Fig. 2), while in the protrusion of this skull the mental foramen is translocated anteriorly to the level of the maxilla canine. On the photographs produced by Colyer (1936) the same translocation of mental foramina is visible. The abnormal position of the mental foramen seems to be an indication of the protrusion due to the intramandibular changes.

In the left mandibular ramus not only is the first premolar absent but between 2 and 3 molars is developed a diastema (Fig. 4.) On the right side, the first, second and third premolars are situated close to one another. Colyer (1936) reported that the absence of the first premolar is fairly common in the Eskimo dog, but in other breeds this tooth and the last molar would appear to be but seldom absent. In the skulls with the absence of teeth, reported by Colyer, not one is connected with protrusion or other abnormality in the dog.

The type of occlusion is similar to that reported by Colyer, but the

XUM

abnormality in the premolar occlusions only, together with the developmental dental abnormality and with translocation of the mental foramen, strongly suggested congenital malformation located in the region of the mental foramen.

The depth of the internal impressions of the occipital bone points to the changes in relations between the central nervous system and the skull. These observations correspond with those of Courville (1945) (p. 77), who from autopsy of 30,000 human corpses concluded that osteal malformations often indicated abnormalities in the central nervous system.

The incompletely developed squama is covered by the powerful neck muscles, but it must still produce the "punctum minoris resistentiæ" in the living organism.

The disseminate superficial osteoporosis of this skull complicated the whole picture.

Summary

1. In this paper is described the type of malformation characterised by occipital and mandibular dysplasia, as well as by osteoporosis and dental abnormalities.

2. The mental foramen in the protruded mandible without abnormality in the position of incisors is translocated anteriorly. It is located on the level of the upper canine.

3. The asymmetrical changes in mandibular teeth and diastematic changes are reported.

Acknowledgment

I am greatly indebted to Professor T. K. Ewer for his interest and kindness in reading the manuscript.

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REVIEWS

INDEX OF DIAGNOSIS (Clinical and Radiological), by Hamilton Kirk, M.R.C.V.S. Fourth Edition. Pp. viii + 668, 326 illustrations. London: Baillière, Tindall & Cox, Ltd. Price 45s.

THIS new edition will be a welcome addition to the woefully small number of small-animal reference books. It is by no means perfect, but much of the old material has been revised and some first-rate additions have been made.

Amongst these new additions are sections dealing with Hard Pad, or Para-distemper, as the author prefers to refer to this disease, and with Rubarth's disease or Contagious Canine Hepatitis, whilst a revision and enlargement of

existing sections such as those on the Leptospiroses and poisons has also taken place.

The annotation on Hard Pad is particularly well done, and much of the more recent authoritative literature is referred to. With Canine Hepatitis the author is faced with a considerably more difficult task, but the presentation is very creditable, the knowledge at present available being set out in as helpful a manner as possible.

Some of the references to Leptospirosis, however, though extended and revised, are still a little confusing. It would perhaps be of considerable help were some of the old material more drastically revised, and brought into line with the new additions. Greater differentiation might then be made between the distinct syndromes of parenchymatous jaundice due to *L. icterohæmorrhagiæ*, and nephritis due to *L. canicola*, with a closer correlation between Stuttgart's disease and the latter organism.

Obviously a book of this type, which embodies much that is the author's own experience, cannot hope to be exhaustive, but perhaps one might expect a reference to zinc phosphide under phosphorus poisoning, or the inclusion of benzyl benzoate and metaldehyde poisoning, all of which occur from time to time in small animal practice.

Perhaps it should also be said that, excellent though many of the X-ray reproductions are, the publishers and author might extend their revisions further in this direction, in view of the increasing interest in this field and the recent improvement of machines and techniques.

In spite of these suggestions, which are intended to be constructive rather than critical, it cannot but strike one very forcibly how considerable has been the amount of reading and re-writing that took place prior to the publication of this new edition. Major H. Kirk must be congratulated on his industry and considerable achievement in producing this, his fourth edition in fourteen years.

Baillière, Tindall & Cox, Ltd., have returned to their standard green-and-gold uniform, but what regret practitioners may have in the loss of the distinctive blue-and-gold, will no doubt be compensated by the better quality of the new edition.

MANUAL OF VETERINARY CLINICAL PATHOLOGY, by David L. Coffin, V.M.D. Third Edition. Pp. xiv + 322, 73 illustrations, 4 plates. New York: Comstock Publishing Co. Inc. London: Baillière, Tindall & Cox, Ltd. Price 42s.

THIS is a good book dealing with laboratory aids to clinical diagnosis, and it can be strongly recommended both to the veterinary student and to the practising veterinary surgeon. The particular technical methods described in it are generally simple and well within the range of everyday practice, while in appropriate cases specialised methods are given for pursuing a diagnosis more closely. The methods advocated are clearly described, and the indications for their use are plainly given. There are plenty of informative illustrations, and some handy tabulations of material to facilitate reference.

XUM

The author first deals in two chapters with the use of the microscope, and with methods of collecting and forwarding specimens from particular cases for laboratory examination. The third chapter gives methods for parasitological examination, particularly of fæces, and is fully illustrated. The next two chapters are concerned with the methods of examination of urine, and with the interpretation of the results obtained. Chapter 6, entitled " Diagnostic Interpretation in Clinical Chemistry," deals mainly with the detection of renal, pancreatic or hepatic insufficiency, and also refers to the clinical pathology of disturbances of calcium and phosphorus metabolism. It is noted in passing that diabetes mellitus is seen more commonly in cats than in dogs at the Angell Memorial Hospital.

The next two chapters, perhaps the best in the book, are concerned with hæmatological methods and their application, and particular mention may be made of some instructive Kodachrome pictures of the hæmatocrit findings in various sick dogs—these will surely and rightly still further encourage the use of the hæmatocrit tube as a diagnostic aid. Incidentally, it is recorded that three cases of myeloid leukosis are thought to have been encountered in dogs in the author's laboratory. The next chapter deals with diagnostic methods in bacterial diseases, and the tables given should be helpful in indicating what to look for in smears in the various conditions which are grouped according to symptoms and lesions. The author then enters in more detail into the diagnosis of such conditions as leptospirosis, mastitis, and pyelonephritis. Short succeeding chapters refer to diagnostic methods in fungus diseases, and in blood and genital diseases due to protozoa, and then follows an interesting account of the use of smears and other aids to diagnosis in virus diseases such as virus hepatitis of the dog. After a description of the examination of semen, the book ends with a chapter on autopsy methods applicable to poultry and cage-birds, and some notes on reagents and on staining techniques. There is a good index.

Throughout the book particular care is given to the discussion of the interpretation of results obtained by the various methods. The outlook is essentially a practical one, but references to the literature will encourage further reading. The book is written for American workers, but this does not detract from its value. The binding and production, apart from a few misprints, are worthy of the contents, and the book cannot be considered to be expensive.

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